An Assessment of the National Significance of Cultural Resources for the Walnut Canyon Special Resource Study

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Executive Summary:

The Omnibus Public Land Management Act of 2009 (Public Law 111-11) directs the "Secretary of the Interior and the Secretary of Agriculture, acting jointly to conduct a study of the study area to assess the suitability and feasibility of designating all or part of the study area as an addition to Walnut Canyon National Monument" (Figure 1.1). In order to establish a new National Monument or Park, the National Park Service (NPS), an agency within the Department of the Interior (DOI), must conduct a Special Resource Study (SRS).

As part of a SRS, if the resources being focused on are cultural resources then these resources must be nationally significant (2006 NPS Management Policies, Chapter 1.3.1) as per the criteria for establishing a National Historic Landmark (36 CFR Part 65). If cultural resources are found to be nationally significant then a new Monument or Park to can be created or an existing Monument or Park can be enlarged.

The Museum of Northern Arizona (MNA) has entered into a cooperative agreement with the Department of the Interior to assess only the National Significance of cultural resources within the Walnut Canyon SRS study area outside of the current boundaries of Walnut Canyon National Monumnet (WACA). The task at hand consists of identifying any properties in the study area that are individually nationally significant or identifying a group or cluster of properties that collectively is nationally significant.

Based on previous research and the analysis of existing and newly acquired archaeological data, MNA suggests that no nationally significant cultural resource properties are present in the study area outside of WACA.

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Chapter 1: Introduction

The Omnibus Public Land Management Act of 2009 (Public Law 111-11) directs the "Secretary of the Interior and the Secretary of Agriculture, acting jointly to conduct a study of the study area to assess the suitability and feasibility of designating all or part of the study area as an addition to Walnut Canyon National Monument" (Figure 1.1). In order to establish a new National Monument or Park, or change the boundaries of an existing Monument or Park, the National Park Service (NPS), an agency within the Department of the Interior (DOI), must conduct a Special Resource Study (SRS).

As part of a SRS, if the resources being focused on are cultural resources then these resources must be nationally significant (2006 NPS Management Policies, Chapter 1.3.1) as per the criteria for establishing a National Historic Landmark (36 CFR Part 65; see below) in order for a new Monument or Park to be created.

The criteria for National Significance are:

> (a) Specific Criteria of National Significance: The quality of national significance is ascribed to districts, sites, buildings, structures and objects that possess exceptional value or quality in illustrating or interpreting the heritage of the United States in history, architecture, archeology, engineering and culture and that possess a high degree of integrity of location, design, setting, materials, workmanship, feeling and association, and:
>
> (a)(1) That are associated with events that have made a significant contribution to, and are identified with, or that outstandingly represent, the broad national patterns of United States history and from which an understanding and appreciation of those patterns may be gained; or
>
> (a)(2) That are associated importantly with the lives of persons nationally significant in the history of the United States; or
>
> (a)(3) That represent some great idea or ideal of the American people; or
>
> (a)(4) That embody the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style or method of construction, or that represent a significant, distinctive and exceptional entity whose components may lack individual distinction; or
>
> (a)(5) That are composed of integral parts of the environment not sufficiently significant by reason of historical association or artistic merit to warrant individual recognition but collectively compose an entity of exceptional historical or artistic significance, or outstandingly commemorate or illustrate a way of life or culture; or
>
> (a)(6) That have yielded or may be likely to yield information of major scientific importance by revealing new cultures, or by shedding light upon periods of occupation over large areas of the United States. Such sites are those which have yielded, or which may reasonably be expected to yield, data affecting theories, concepts and ideas to a major degree.

The Museum of Northern Arizona (MNA) has entered into a cooperative agreement to assess the National Significance of cultural resources within the WACA SRS study area outside of the current boundaries of WACA. The task at hand consists of identifying any properties in the study area that are individually nationally significant or identifying a group or cluster of properties that collectively is nationally significant.

The current assessment asks the question: Are there nationally significant cultural resources present outside of the current boundaries of WACA within the study area? WACA is considered nationally significant due to Sinagua culture cliff dwellings. The study area contains portions that could contain additional cliff dwellings, but also encompasses environmental zones that contain other types of cultural resources. Other environmental zones in the project area consist of sections of the Walnut Canyon drainage other than cliffs with southern exposure, the top of Anderson Mesa, and the Sinclair Wash/Rio de Flag drainage. Examples of other types of cultural resources include non-canyon related Sinagua culture manifestations such as sites with one to three room masonry structures and artifact scatters, sites consisting solely of artifact scatters, sites from the Archaic (8000-1000 B.C.) period consisting of artifact scatters, and a diverse array of sites dating to the historic use of the project area. Are cultural resources in other environmental zones within the study area nationally significant on their own, are they nationally significant as clustered phenomena in conjunction with those in WACA, or are they not nationally significant? These are the kinds of questions this assessment will grapple with.

The report is structured in the following manner. In addition to the introduction, it is comprised of six chapters: Chapter 2 describes and interprets the current environment and paleoenvironment of the study area; An essay by David R. Wilcox titled “Prehistoric Previous Research and Culture History Relevant to the Walnut Canyon Study Area and Its National Significance” constitutes Chapter 3; Previous research regarding the historic occupations in the study area and its attendant cultural history is the subject of Chapter 4; The results of new archaeological survey in the study area is presented in Chapter 5; Chapter 6 engages in spatial analysis of prehistoric archaeological survey data from the study area and a larger regional study area; and Chapter 7 is an assessment of national significance of cultural resources in the study area. Our goal is to examine the patterning and range of variability in the pertinent archaeological and environmental data and interpretations about them, both others as well as our own, to assess whether or not a claim of national significance is warranted for cultural resources properties in the study area.

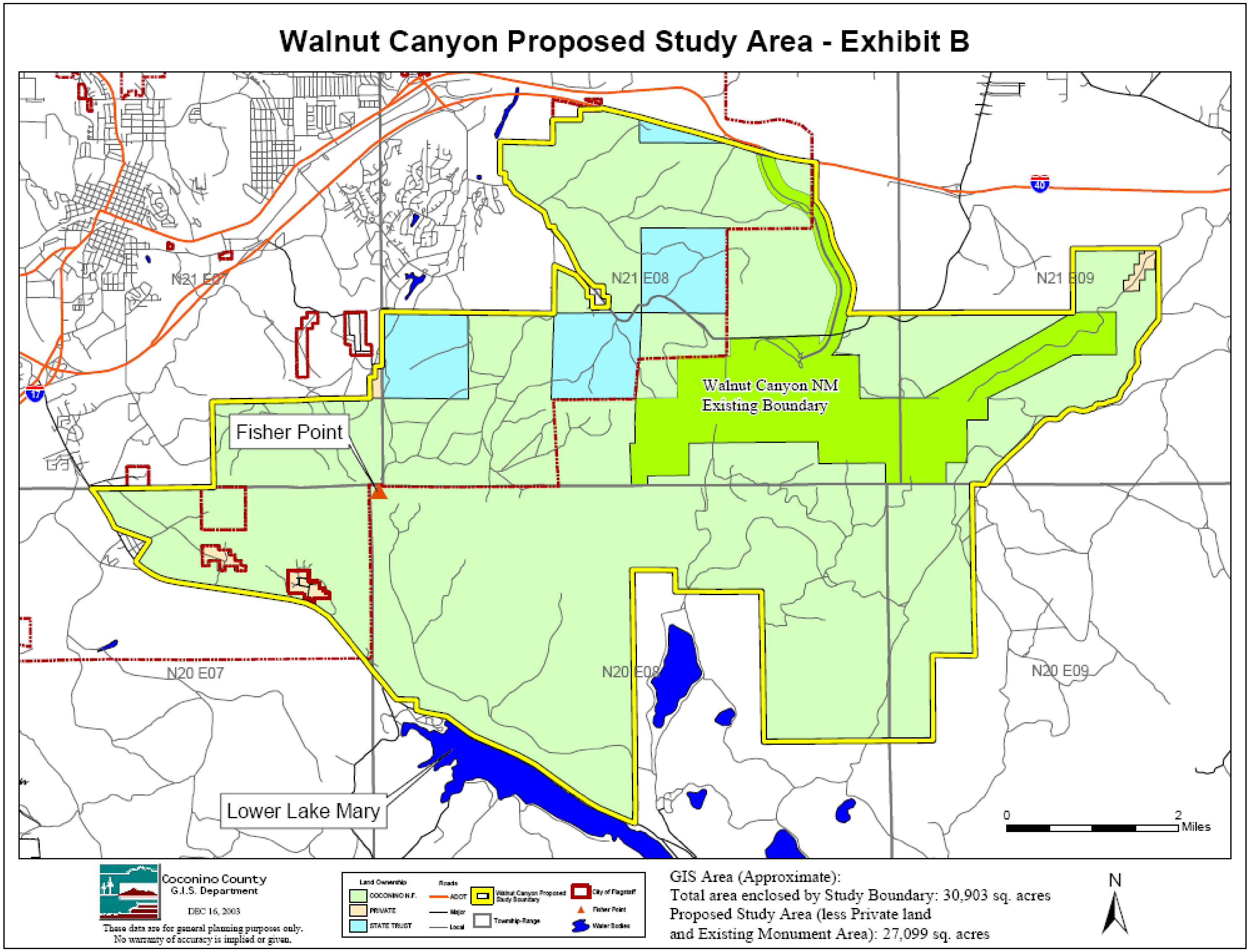

Figure 1.1. The Study Area.

Chapter 2: Environmental and Physiographic Description of the Walnut Canyon National Monument Special Resource Study Area

The physiographic setting of Walnut Canyon exemplifies the natural beauty seen elsewhere in canyon settings of the Colorado Plateau, though in a relatively compact setting. The main attraction is the cliff dwellings of the Sinagua, made all that more impressive by the backdrop of the Ponderosa pine forest and the exposed bedrock cliffs. The combination of nearly 125 meters deep (about 400 feet) grey and white escarpment, the constant evergreen color of Ponderosa pine trees, and well-preserved archaeology sites provide a treasure of natural history, just a few miles southeast of Flagstaff. At the bottom of the canyon the ephemerally flowing Walnut Creek meanders for about 29 kilometer between Fisher Point and the eastern end of the monument. After exiting the monument east of First Fort, Walnut Creek is no longer confined by steep narrow bedrock walls. Today, Walnut Creek flows only when lower Lake Mary overflows its spillway, usually due to large late winter or early spring snowmelt. When Lake Mary does flow, water travels eastward through Walnut Canyon eventually reaching the Little Colorado River.

Rim elevations range from 2133 m (7000 ft) at Fisher Point, 2060 m (6760 ft) at the Visitors Center, and 1926 m (6320 ft) at the eastern end of the monument. The elevation of the canyon bottom below Fisher Point is 2011 m (6600 ft), and below the Visitors Center is 2060 m (6360 ft). This provides a relief from canyon rim to canyon bottom of about 122 m (400 ft) for much of its length in the monument. In the eastern end, near First Fort, the relief shallows to about 55m (180 ft).

Physiographic features observable from the rim of Walnut Canyon include the basalt capped Anderson Mesa and Mormon Mountain to the south, and glimpses of cinder cones and other volcanic features of the San Francisco volcanic field to the west, north, and east. Like many canyons in the region, Walnut Canyon has a meandering pattern cut into bedrock.

The following discussion provides a physiographic and environmental context for the cultural resources of Walnut Canyon National Monument (WACA) and the study area. The contexts of the environment and physiographic setting used to discuss the archaeological resources include geology, faulting, soil, and climate. These topics are framed to emphasis their direct significance for interpreting the environmental factors of significance to the ancient Sinagua, rather than discussing them in isolation. As such, they include the following topics: (1) bedrock geology and Sinagua cavates, (2) Regional faulting, stream patterns, and alluvial-filled grabens, (3) Holocene geology and chronostratigraphy of Archaic-age deposits, (4) soil types and agricultural inferences for Sinagua farmers, (5) modern climate and paleoclimates of Sinagua occupation, and (6) significance of the physiographic setting to archeology sites.

Bedrock Geology and Sinagua Cavates

A study of the geologic resources of Walnut Canyon was prepared by Graham (2008). Geologic mapping of bedrock units in the Walnut Canyon area was undertaken by Raucci et al. (2003, 2004) and available online (http://www.nature.nps.gov/geology/inventory/publications/map_graphics/waca_map_graphic.pdf).

Walnut Creek has cut through relatively soft, horizontal sedimentary rocks that are characteristic of the Colorado Plateau in general, and the Coconino Plateau specifically (Figure 1). The geologic strata observed at Walnut Canyon are the same as the three uppermost formations at Grand Canyon, including the Kaibab, Toroweap, and Coconino Formation (Figure 2). The three strata are Permian in age, deposited approximately 280-250 million years ago.

The oldest bedrock unit exposed in the project area is the Coconino Sandstone. This formation forms the distinctive grey to white cross-bedded sandstone in the bottom of Walnut Canyon. The cross-bedding is due to its origin as widespread eolian sand dunes. Overlying the Coconino Sandstone is the Toroweap Formation consisting of interbedded sandstone, limestone, and sandy limestone beds. Although the Toroweap Formation forms a broad sloping area between the Kaibab and Coconino Formations, it consists of relatively thin bedding with differential erosion forming alternating slopes and ledges. The differential erosion of the easily eroded sandstone and the more resistant limestone creates the ledges used for the Sinagua cavate habitations. The cross-bedded sandstone layers of the Toroweap are not unlike those of the Coconino Formation, and the limestone beds are not too dissimilar from the Kaibab Formation. Therefore, Raucci et al (2003) did not differentiate the Toroweap Formation from the Kaibab Formation on their map.

Overlying the Toroweap are the beds of the calcareous Kaibab Formation, containing limestone, sandstone, and dolomitic units. Dissolution of the carbonate produces karst and microkarst features that are very rough and sharp. Weathering of the rock surface by dissolution, and the colonization by dark brown, black, green, yellow, and red lichens create a very weathered, grey appearance of the formation. In many locations, dissolution pits have developed into rather large cisterns that can be suitable for storing many liters of water (Downum et al. 1995). The Kaibab can be quite fossiliferous, with the result being concentrations of very hard biogenic silica (chert) layers and nodules.

On the south side of Walnut Canyon are remnants of the dark red to purple sandstone and siltstone layers of the Triassic Moenkopi Formation. Intact Moenkopi Formation is only preserved where it underlies the basalt flows of Anderson Mesa. There are no mapped areas of Moenkopi on the north side of Walnut canyon. However, visible on the ground and from aerial images, there are sandy reddish soils and sediments that are most likely remnants of long eroded Moenkopi. While no intact bedrock occurs, abundant sediment derived from the Moenkopi Formation can be found. These sandy deposits provide good infiltration of rainwater into the underlying soils and improve agricultural potential of the normally clay-rich soils.

Basalt of Miocene age (about 5 to 23 million years ago) and Pleistocene age (about 2 million years ago to 10,000 years ago) occurs on the south side of Walnut Canyon. The Anderson Mesa basalt dates to 6.39 million years old. During that time, Anderson Mesa must have been an old valley bottom when the basalt layer was emplaced. Subsequently, erosion of the surrounding landscape left the more resistant basalt on a high spot, producing inverted topography. Younger basalts occur near the headwaters of Walnut Canyon closer to the elevation of the modern drainage. One of these, called the Walnut Canyon basalt, flowed into an already present Walnut Canyon. This flow dates to about 800,000 years ago, indicating that Walnut Canyon was already in existence at that time.

Tectonic activity and faulting in the area are part of the Lake Mary fault system, a component the Northern Arizona Seismic Belt (NASB). The NASB is a zone of regional seismicity and faulting that last saw significant earthquake activity in the early part of the 20th century. Magnitudes of 6.0 and 6.2 were recorded, and it is thought that a maximum earthquake with magnitude 7.0 is possible (Pearthree et al. 1996; Bausch and Brumbaugh 1997). The Anderson Mesa fault and Marshall Lake graben are north-trending components of the Lake Mary fault system. The Lake Mary graben and numerous other smaller faults and jointing patterns are part of a northwest trending component that is also expressed as northwest to southeast trending joints that cross Walnut Canyon and help to control the stream pattern of Walnut Creek and its tributaries.

The differential weathering of the various bedrock layers of the Toroweap and Kaibab Formations creates the setting where the natural alcoves occur where the Sinagua constructed their stone houses. Basically, less resistant layers weather more rapidly than more resistant layers. When more resistant layers alternate with less resistant layers a situation develops with an overhang forming a resistant roof to the shelter (or alcove), underlain by a more easily weathered recess into the bedrock forming the actual alcove. Underlying the alcove is a more resistant layer that forms the floor of the shelter. According to a study by Shimer and Shimer (1910) they documented in great detail the alternating layers of more resistant and less resistant layers, and identified three levels where alcoves formed that contained Sinagua homes. They described the triplet of more resistant floor and roof, and less resistant shelter. They also described the resistant floor as commonly composed of a bedrock layer with a higher concentration of siliceous nodules (Figure 3a). These nodule layers are possibly fossil sponge beds that commonly occur in the limestone units in the area. The alcoves contain a variety of Sinagua features, from connected roomblocks containing many rooms representing continuous, permanent habitation, to small masonry storage features and fieldhouses. Oftentimes only remnant walls are present (Figure 3b).

There may be several processes that lead to the differential weathering of the various layers including characteristics of the bedrock units that might be more susceptible to weathering such as different types of cementing agents, different weathering capabilities of sandstone, limestone, and dolomite. The permeability of the units such that water may seep out of certain units rather than others and this may be related to the types of rock, and/or to the location of fractures, faults, and joints. Weathering also can be related to the presence of salts, both chemically and physically breaking down particles. Perhaps some or all of these are occurring at Walnut Canyon. One rather rare occurrence of exfoliating rock was recorded in an alcove area in which vertical fractures parallel to the alcove wall are released from the bedrock in vertical planes and become separated, eventually overturning and rotating away from the wall. This appears to be a process related to exfoliating whereby there may be some vertical jointing or planes of weakness that lead to more rapid weathering, but after the weathering occurs, the release of the confining rock leads to a release of pressure and more rock slabs exfoliate (Figure 4a and b).

Regional faulting, stream patterns, and alluvium-filled grabens

Ancient tectonic activity related to the NASB produced distinct rectilinear patterns across the landscape. The jointing and faulting of the bedrock surface expression and the subsurface cracks through the bedrock, controls water flow and stream pattern. The north-south and northwest-southeast trend of fault and joint orientations, superimposed over the regional northeast dip towards the Little Colorado River, characterizes the distinct rectilinear pattern of Walnut Canyon.

Based on aerial photographs and topographic maps, Walnut Canyon can be informally divided into five sections based on the joint and fault controlled drainage orientation of Walnut Creek (Figure 5). Three of the sections trend to the northeast while two trend towards the southeast, with nearly right angle bends between sections. The westernmost section, at the confluence of Fay, Skunk, and Walnut Canyons, trends to the northeast for about a kilometer, then bends to the southeast for 2.5 km. The next section, containing numerous bedrock meanders and the Visitors Center bends to the northeast for 5.5 km. At the location of the WACA Visitor Center, Walnut Creek again bends to flow in a southeast direction for 3 km. The final section then bends again to flow in a northeasterly direction for about 4.0 km until it exits the Monument. It continues in this direction outside of the Monument for another 3.25 km until it is no longer confined within canyon walls. The straight line length of these five sections provides a total valley length of about 19.5 km. This is compared to the length of Walnut Creek along its meandering thalweg, which is about 28.7 km. The valley length to stream length ratio provides a characterization of the sinuosity of the creek. Values of 1.5 or greater are termed meandering. The ratio for Walnut Creek is 1.47, close enough to call it a meandering stream though obviously some sections are straighter than others. If we look at section three where most of the meanders are found, the ratio climbs to 1.62.

Based on the above discussion, it becomes apparent that the fault and joint orientation control the bends in the drainage pattern of Walnut Creek. Meanders occur in the stream at these bends. As the river flowed in a meandering pattern it created relatively isolated promontories in the stream, forming what have been called bedrock peninsulas. It is in this geomorphic position, perched high on the bedrock peninsulas, that the five Sinagua Forts are situated. In addition, Forts 2, 3 and 4, are located on bedrock peninsulas where the regional jointing patterns intersect. Thus we can directly relate the fracture patterns in the underlying geologic framework to the creation of meandering patterns of Walnut Creek, which in turn formed the promontories where the Sinagua chose to build their series of forts.

The surface drainage patterns are directly related the underlying geologic framework. North of the canyon, the dominant drainage direction is towards the north and northeast, away from Walnut Canyon. In fact, only the area immediately along the rim drains into the canyon. To the west, the headwaters of Skunk and Fay Canyons drain into Walnut Creek below Fisher Point. At some time in the distant past, perhaps prior to about 800,000 years ago, Walnut Creek did not flow through the Lake Mary graben, but more likely emanated from headwaters in Fay and Skunk Canyons (Rauuci et al. 2003). Grabens are linear features that show downward movement of bedrock relative to their sides. Nowadays, however, water from Lake Mary reaches Walnut Canyon only when the spillway overflows. Water draining into Lake Mary comes mostly from the southwest, including tributaries such as Priest and Howard Draws. A dense drainage network south of Walnut Canyon drains the western edge of Anderson Mesa, from about Fisher Point to the Monument boundary. A less dense drainage network that nonetheless flows into Walnut Canyon downstream of the Visitors Center drains the eastern edge of Anderson mesa. The dominant trend of all drainages is towards the northeast, in the direction of the Painted Desert and the Little Colorado River. Small, internally drained basins that hold water year round characterize the surface of Anderson Mesa. The largest in this area is Marshall Lake, located in the north-south trending Marshall Lake graben. This process is thought to relate to the extension of the earths crust as it is being pulled apart along normal faults. This downward movement, which occurred perhaps millions of years ago, created linear valleys filled with alluvium derived from upslope sources.

The linear pattern of jointing and faulting along the canyon edge creates linear zones of increased water flow and moisture leading to increased weathering and erosion. These processes enhance the joints and faults to create linear chutes to the canyon bottom. The chutes are pathways to more easily ascend or descend the steep canyon walls, and were undoubtedly used during prehistoric times for such purposes.

The patterns of jointing and faulting created the shallow north, northeast, and northwest trending graben valleys. The geomorphic position of these alluvial-filled grabens lends them to being good areas to practice prehistoric agriculture. The grabens receive surface runoff so the soils are moister, and they accumulate organic matter and nutrients. Holocene and Pleistocene deposits found in these valleys are a combination of material derived from the local weathered bedrock units (sandstone, limestone, dolomite), basalt, and volcanic cinders. There are also occurrences of surface and buried soils in the Holocene alluvium (see below). A few studies of the ages of surficial deposits in Walnut Canyon and the surrounding area indicates an age range from about 10,000 years ago, through the Archaic and Puebloan periods, and into the historic record (Anderson 2001; Richardson 2003; Joyal 2004; and Neff et al. 2003).

Holocene Geology and Chronostratigraphy of Early Archaic to Puebloan-aged deposits

The alluvial setting of WACA can be characterized as two general zones of alluvial activity; the canyon bottom alluvium related to Walnut Creek (including alluvium in tributary canyons), and upland alluvium in tributaries and alluvial fans. Small alluvial fans draining the bedrock interfluves are tributaries to the alluvial valleys. Buried soils and charcoal within these deposits provide valuable information on the ages and geomorphic processes responsible for the landscape we see today. Alluvium within Walnut Canyon also provides valuable information on the process active in Walnut Creek, and for interpreting the landscape during prehistoric occupation of the area. There have been very few geoarchaeological studies in the Walnut Creek drainage basin. Anderson (2001) studied soils and sediments of alluvial terraces at First Fort. Richardson (2003) and Joyal (2004) investigated ages and surface processes of Holocene alluvium in upland tributaries and alluvial fans. Neff et al. (2003) compiled the radiocarbon ages of the three previous studies mentioned above to derive a landscape model related to Archaic through Puebloan-aged deposits (Table 2.1).

Pottery sherds associated with the major occupation of First Fort were found at a depth of 17 cm, and a radiocarbon age obtained on charcoal at a depth of 88 cm had a calibrated age with three intercepts of 5280±50, 5155 ± 50, and 5145 ± 50 BP (BP = “before present” with the present defined as the year 1950 A.D.). Hereford (unpublished data) sampled the same terrace across Walnut Creek from First Fort. Three radiocarbon samples at the base of an approximately 4 meter deep trench returned ages of 8985 ± 70, 8980 ± 80, an 9420 ± 70 BP. He also obtained and age of 970 ± 50 BP at the uppermost layers of the terrace. Alluvial sediments preserved in these stratigraphic sections revealed floodplain aggradation occurring during the early Holocene and lasting to shortly after about 5000 BP, when the terrace was stabilized. Subsequent soil formation and cultural use and deposition on the terrace continued until the prehistoric use of the area. Although the age of the recent Walnut Creek arroyo formation is unknown, it may have occurred at the same time as the major period of erosion in the southwest between about 1880 and 1920, or so.

Richardson (2003) investigated alluvial deposits in tributaries and adjacent alluvial fans in the upland areas above Walnut Creek (Figure 6). He found a sequence of deposition from early Holocene to recent. In Fay canyon, he found alluviation occurred between 10720 ± 215 BP and 5460 ± 60 BP. These ages are similar to those of Anderson at First Fort and suggest a period of latest Pleistocene/Early Holocene aggradation that lasted through the Middle Holocene. The alluvial surface stabilized and a thick soil developed. Accumulation of organic matter and charcoal in the soil continued to the historic period, indicated by a radiocarbon age of 380 ± 70 BP in the surface layers. In a nearby tributary to Rio de Flag, Richardson obtained radiocarbon ages at the bottom of a stratigraphic sequence of 9490 ± 35 BP, and near the top of the section of 3980 ± 90 BP. These ages suggest similar processes are preserved in all three profiles (canyon bottoms and uplands) when aggradation stopped sometime after about 5000 BP and possibly as late as 4000 BP. The uppermost soil layers date to the latest Holocene, with the youngest dates in the Rio de Flag section dating to 540 ±20 BP.

Based on these results, Neff et al. (2003), proposed a model of landscape development related to periods of erosion, deposition, and stability that might be used to understand Archaic period occupation in the area (Figure 7). This model proposes a cool/moist Pleistocene climate leading to overall sediment production and storage on hillslopes and alluvial settings. During the Late Pleistocene to early Holocene transition to warmer and drier conditions, hillslopes become less vegetated and sediment is eroded from them. However, the alluvial settings do not have the capacity to transport material out of the system, thereby leading to aggradation. During the Middle Holocene, barren hillslopes would lead to surface runoff. In the alluvial settings the general aggradation (due to the low transport capability of the low gradient, ephemeral streams) gives way to periodic erosion occurs due to periods of increased runoff and geomorphic factors. This is recorded in small channels in Fay Canyon as well as in small alluvial valleys towards the Mogollon rim (Joyal 2004). Here he documented erosion and channeling during the Middle Holocene, after about 5000 BP. Later ages in are similar to those seen closer to Walnut Canyon, being late Holocene to historic. A period of 3000 to 4000 years between about 5000/4000 BP and 2000/1000 BP represents a period of erosion in all sections analyzed. The landscape model proposes that during the transition from Middle Holocene to the later Middle Holocene, stability and soil formation (as seen at First Fort and Fay Canyon) is coincident with gully formation (as seen at Lone Tree and Dick Hart and Houston Draws (Joyal 2004). This landscape model then predicts that early to Middle Holocene archaic cultural remains are preserved in alluvial settings. During the transition to later Middle Holocene erosion of alluvial valleys would have removed artifacts from that period. Late archaic and puebloan artifacts are anticipated to be preserved in later Holocene settings, on terrace tops, and incorporated into the accumulating surface soils.

Alluvial chronostratigraphic studies indicate that surficial deposits date back to the past 10,000 years in WACA. Much of the Holocene, including early to middle Archaic and puebloan period sites are preserved. Late middle Holocene erosion removed sites of this age (and possibly earlier). These studies provide an understanding of age control on soils and sediments related to the cultural periods. Through an understanding of the chronostratigraphy in the WACA area, we can interpret periods of erosion and stability, and perhaps relate these documented landscape responses to cultural resources and climatic variability.

Soil Types and Agricultural Inferences for Sinagua Farmers

Like many other groups in the region, the Sinagua made their living primarily as farmers. Based on archaeological, ethnographic, geomorphic, paleobotanical, and other studies, the primary food crops were corn, beans, and squash. These three main staples were supplemented with what could be harvested nearby, such as pinyon nuts, acorns, and the like (Downum 2000). However, for these and other sedentary agriculturalists successful and predictable crop yields were a necessity that was often difficult to come by. The Sinagua needed surplus food to survive through the winter and to stockpile against years when yields were low. During good years, with stockpiles full, corn was undoubtedly used as a trade item to acquire other necessities. In this section, we discuss the types of soils in the study area, and in the next section we discuss climates and paleoclimates as they relate to the period of occupation and potential impact on crop growth.

In the arid southwest it can be difficult to rely on abundant crops year after year particularly when the primary limitation on crop production is unpredictable rainfall. Life would have been difficult during times of persistent drought. Additional weather-related problems include shortened growing seasons due to disadvantageously timed early or late season frosts (Salzar 2007). Other factors influencing crop growth include microenvironmental conditions related to elevation, slope, and aspect. Another main limitation is related to the substrate in which plants grow – the soil. Many properties of soil affect plant growth including the various proportions of sand, silt, clay, and gravel; infiltration, porosity, and permeability; and nutrient status. In the arid southwest, in most soils, the nutrients that are potentially limiting to healthy plants are the availability of nitrogen and phosphorus. Below we discuss the different types of soils in the project area in terms of how they relate to potential crop production and general fertility. This discussion is based largely on data available at the Cooperative Soil Survey site (http://soilsurveydemo.org/index.asp) and from a study of soil fertility at First Fort in Walnut Canyon (Anderson, 2001).

Soils are a product of environmental factors including climate, bedrock geology, plant and animal types, and topographic characteristics such as slope and elevation. All things being equal, older soils are better developed than younger soils. Given these factors, soils in the study area are a product of low rainfall (about 20 inches per year) and temperatures that average about 50° F. Bedrock geology consists predominantly of sandstone and limestone, with the occasional additions of basaltic cinders and aerosolic dust. Soils are forming directly on the bedrock or in material redeposited from the bedrock such as in the alluvium-filled graben valleys discussed above. The vegetation varies from rim to canyon bottom, but is dominated by plants found in the pinyon-juniper woodland ecosystem (see also Table 2.2). Topography is relatively flat on the rim, with very minor relief. The canyon itself is steep sided and it is difficult for soils to develop there. The ages of the soils in alluvium can be greater than 10,000 years old (see above), and soils that are on the flat limestone bedrock are certainly much older. Most soils are polygenetic, that is the properties we see today are a function of the long period of time, perhaps thousands or hundreds of thousands of years during which climate and vegetation have varied. Due to these complexities, our discussions are restricted to a general characterization of the soil types in the area.

Soils in the area include the following four soil orders (soil great group in parentheses): 1) Mollisols (Haplustolls and Argiustolls); 2) Entisols (Cryorthents and Ustorthents); 3) Aridisols (Haplargids); and 4) Alfisols (Haplustalfs) (Figure 8). In general, Mollisols are grassland soils that have relatively thick, dark, organic-rich surface A horizons. Entisols are relatively weakly developed soil horizons due to either being young soils, or being shallow soils on bedrock. Aridisols are soils in arid environments; in this case, arid microenvironments such as the mesa tops. Alfisols are well-developed forest soils with high concentrations of the basic cations (calcium, magnesium, potassium, sodium). So, if one is properly versed in soil jargon, just by looking at the soil orders one can tell that the soils in the study area are characterized by poor to well-developed properties, they can have a high basic cation concentration, and occur in forested, grassland, and arid settings (Table 2.2).

Soil classification employs unusual combinations of words. Many of these terms have their origins from Greek, Latin, English, German, and Russian. The terminology was designed to provide information about the conditions under which soils developed, and therefore has implications for climate, vegetation, geology, and age of the landforms in the area. For example, the term “ust”, which appears in all of the great groups in the project area, signifies a dry soil moisture regime. Another term common to many of the soil great groups is “hapl”, meaning “haploid” which in this case means simple soil horizonation. It is not necessary to go through all of the meanings of these great groups in any detail here. A summary of the important qualities of the soils is found in Table 2.2. In general, the plant communities in the WACA area are dominated by those found in the pinyon-juniper woodland ecosystem. For each of the soil types listed in Table 2.2, the associated plant communities are indicated. This data is from the online version of the Cooperative Soil Survey (http://soilsurveydemo.org/index.asp).

Soils on the canyon rim are variable, with the Alfisols and Mollisols having good nutrient status with no limiting factors. The Entisols are weakly developed, but they can also have adequate nutrients. One characteristic of Entisols can be its relative shallowness to bedrock. In many parts of the world a shallow soil is an impediment to root penetration and therefore plant growth. However, in arid environments, the presence of a relatively permeable surface soil above an impermeable layer (such as clay, petrocalcic, or bedrock layer) creates a perched water table, of sorts, that can hold water in the root zone for a longer period of time. Many areas along the rim are at an elevation and aspect where the temperature allows for a sufficiently long growing season, precipitation is adequate (if soil moisture retention techniques are employed), and the soils have sufficient nutrient status.

The soil order and great group terminology of soil classification used above is most closely related to defining soil properties. A further organization of soils refers to soil series, which are specifically defined soils for a given area, commonly differentiated based on topographic position. Within the definition of each soil series is the information as to order, great group, sub group etc. For example, the Tortuga soil series is a variation of a Lithic Haplustoll. Table 2.2

presents valuable information about the various soil series found in the study area. Although there are nine different soil series, Jacques, Boysag, Daze, and Tortuga are the dominant types (Table 2.3). Jacques soil series are those in the alluvial settings, including the alluvial grabens discussed above. These are prime areas for agriculture. Indeed, agricultural rock alignments were found in similar settings. These soils are deep and well-drained Mollisols with lots of organic matter and high nutrient status. Daze and Tortuga are also Mollisols and are good soils with no limiting factors. The shallowness of these soils is a potential benefit because they hold water in the root zone. Boysag series soils are located on the tops of the low ridges and mesas in the study area and are drier, in general.

New archaeological survey was carried out in the study area in units W, X, Y, and Z (see Figure 2.1). Unit W is along the north side of Walnut Canyon where the steepest terrain was encountered and where the steep parts of Tortuga is mapped. The steepness of these soils would limit their use for crops, though it is probable that other economically useful plants, such as yucca, may have grown here in abundance. Unit X and Unit Y are dominated by Daze (Lithic Argiustoll) and Boysag (Ustic Haplargid) soil series. These soils are good for prehistoric corn agriculture, though Daze is better than Boysag because of its topographic location retaining moisture. Rock alignments were recorded in Unit Y in the limited but important Jacques soil series of the alluvial drainages. The soil map does not extend to Unit Z but the setting is similar to that of Units X and Y. Therefore, it is assumed that Daze, Boysag, and Jacques soils are present here as well and that the best of these is the Jacques series found in the alluvial deposits in the graben valleys. Most of the rim is Daze soil series (Lithic Argiustoll), with Tortuga-Daze (Tortuga is a Lithic Haplustoll) in the headwaters of small drainages at higher slopes (Table 2.3).

The soils in Walnut Canyon bottom have good soil nutrient status. Anderson (2001) investigated soils and alluvial stratigraphy at First Fort. He excavated and described four soil pits. The characteristic soil horizons included the following: A1-A2-A3-A4-2ABtkb-2Btkb-2Bkb-2BCb horizon to a depth of about 1.0 meters. In two of the four pits he sampled 14 soil horizons for particle-size distribution and nutrient analysis, including base cations, nitrogen phosphorus, salinity, sodicity, pH, and percent organic matter. Based on the results of these analysis, he concluded that the soils forming on the high terrace were of sufficient nutrient and physical properties as to have no limiting factors for agriculture. Limiting factors for crop production in the canyon are limited to environmental factors (e.g. rainfall and length of the growing season) rather than soil nutrient status.

In summary, the study area has similar soils throughout, dominated by Mollisols. The best soils are in the alluvial drainages and these are the Jacques soil series of Mollisols. The variety of topographic settings and different slopes and aspects lead to slight variations in soil types. This variation would have provided the Sinagua farmers with good soils and, given the right amount of rainfall and temperature constraints, the area could have been quite productive. There are no limiting factors regarding soil properties or nutrients.

Modern Climate and Paleoclimates during Sinagua Occupation

Climate records at Walnut Canyon have been kept more or less continuously from 1910 to 2010 (http://www.wrcc.dri.edu/). Table 2.4 contains the temperature data, showing the monthly averages, daily extremes, and monthly extremes. The mean annual temperature is 10.2°C

(50.3°F). The mean of the average monthly maximum temperatures is 18.3° C (65°F). The mean of the average monthly minimum temperatures is 2°C (35.7°F). The hottest month is July, with a mean of 22.4° C (72.4°F), and the hottest day of 38.3°C (101°F) occurring on July 10th, 2003. The coldest months are January and December, both averaging 0°C (31.8°F). The coldest day was December 28th, 2003 with a temperature of -21.6°C (-7°F). It is interesting to note that all of the high monthly extreme temperatures have occurred in the past decade, with the exception of December 1910. And the seasonal average high temperatures have all been record highs set in 2006 and 2007. The mean high temperatures for each season have also been set since 2004.

Table 2.5 shows the precipitation data. The wettest month is August and the driest month is June. There is a bimodal precipitation pattern, with Summer receiving an average of 14 cm (5.52 in) compared with Winter's precipitation of 12.5 cm (4.93 in). The mean annual precipitation is 46.0 cm (18.12 in). The wettest year was 1965 with 68.4 cm (26.91 in) and the driest year was 1956 with 24.1 (9.5 in). The highest single day rainfall was 10.3 cm (4.05 in) on 8/13/1987. Snowfall records include the following: 327.7 cm (129 in) set in the 1972-1973 year, 322.8 cm (127.1 in) set in 1967-1968 year, and 263 cm (103.5 in) set in 1996-1997. The most recent big snowfall year was the 2009-2010 season when 254 cm (100 in) fell at the monument (Table 2.6).

Paleoclimate data is abundant for the region in the form of pollen records for lake cores, dendroclimatology, and other sources. Perhaps the highest resolution and most useful data for interpreting past climates related to archaeological interpretations is derived from tree ring records compiled into the North American Drought Atlas (http://iridl.ldeo.columbia.edu/SOURCES/.LDEO/.TRL/.NADA2004/.pdsi-atlas.html). A relatively recent tree ring record from the San Francisco Peaks and the Flagstaff area was combined with regional chronologies from Navajo Mountain and Canyon de Chelly to reconstruct a chronology that dates back to AD 570 (Salzer 2007).

Salzer (2007) comprehensively discusses his data with respect to the tree ring record of precipitation and temperature. He identifies, for example individual years and periods with either high or low precipitation and temperature; periods of mean maximum and mean minimum; extreme years with potentially killing frosts; and periods with high or low variability, and much, much, more. In this section, we only focus briefly on the periods of high or low variability, as these are commonly thought to be important to the interactions of people and their environment. It is thought that while individual years with extreme low rainfall, for example, may yield low crop production, if the antecedent years were favorable, then the inhabitants would have stored surplus crops to get them through the bad years. Of course, many bad years could be disastrous. Also problematic would be the unpredictability of several years with high fluctuations in the magnitude and frequency of rainfall and precipitation.

Salzer identified only one long period of high variability within our A.D. 1000-1300 time frame. The years A.D. 1069 through A.D. 1092 are a period of 24 years when the standard deviation of the precipitation values is high, indicating years of potential stress. However, much of period of Sinagua occupation in WACA is marked by relatively long periods of low variability. For example, the periods A.D. 1018 to 1039; A.D. 1099 to 1148; 1180 to 1219; and 1272 to 1318 are all representative of intervals with low variability in precipitation. These years would have been years in which the prehistoric farmers might have been relatively confident that reliable rainfall could produce sufficient crop yields.

The dendroclimate record lends itself to a better understanding of the impact on prehistoric agriculture such that the record of rainfall and temperature can be used to characterize periods of wet or dry. The record of rainfall and temperature has been combined with other environmental data to produce a Palmer Drought Severity Index (PDSI), which is commonly used to identify wet or dry periods for agricultural purposes, not only today, but in the past. PDSI data is derived from instrumented climate data (e.g. precipitation, temperature, evapotranspiration), water-holding capacity of the soil, and latitude (as an indication of sunlight received). Using the dendroclimate record as a proxy for actual measure rainfall and temperature, a chronology of past wet and drought periods can be identified. Tables 2.7, 2.8; and Figure 9 presents significant years when climate was either favorable or not favorable for agricultural pursuits in the WACA region. Table 2.9 presents groups of years when the PDSI values indicate favorable (moderately, very, and extremely wet years) or unfavorable (severe and extreme drought years.

The following discussion is by no means comprehensive. The implication for negative impacts to crop production is only inferred. Significantly more detailed research into local crop production related to climatic changes could be undertaken to more fully understand the annual variability of crop production needs to be undertaken. The purpose here is to provide some indication of the richness of the paleoclimate data sets, their potential usefulness for interpreting the archaeological record of WACA, and to indicate that important research remains to be done regarding this valuable resource.

Nonetheless, Table 2.9 illustrates some of the periods when the climate was either favorable or unfavorable. For the 200 years analyzed (A.D. 1000 – 1300), the most extreme drought occurred in AD 1005 followed by severe drought in AD 1006. The next two continuous extreme drought years occurred in AD 1035 and 1036. From about AD 1052 through 1066 the climate was favorable with moderate, very, and extremely wet years dominating. AD 1066 was the second wettest year in the 200 years analyzed. The years 1067 and 1068 were severe and extreme drought years, respectively. AD 1079, 1082, 1087, and 1088 were favorable, followed by severe to extreme drought years in 1090 and 1091. The next period includes the wettest year on record, AD 1117. This interval had wet years in AD 1115, 1116, 1117, and 1120. A relatively long period of severe and extreme drought years occurred from AD 1126 through 1158. This extended drought period is widely recognized throughout the southwest as a regional drought period that most likely caused reduction in crop production in both yields and reliability. A favorable period occurred in AD 1197, 1200, 1201, and 1202. Drought conditions returned for the AD 1215, 1217, and 1218. AD 1217 was the third most extreme drought year. AD 1229 through 1242 was generally favorable, whereas AD 1246 through 1258 was generally drought and extreme drought conditions. The second most extreme drought year occurred in AD 1251. AD 1267 and 1268 were good years and AD 1286 and 1288 were drought years.
It is likely that several severe and extreme drought years in a row would have caused stress due to food shortages. However, it may be as detrimental to have years in which the climatic variability was extreme (favorable years alternating with unfavorable years) or periods when the inhabitants could not depend or adjust to changing conditions. The most favorable condition for subsistence farmers are conditions that could be depended on. Even if there were unfavorable

years or periods, they could adjust their lifeways to try and accommodate. Nonetheless, the continuous presence of the Sinagua farmers from the late 11th century through the middle of the 13th century is a testament to their ability to adapt to variable climatic conditions. Undoubtedly they were accomplished in supplementing their corn, bean, and squash yields with local plant and animal resources that would have played a larger role in their food procuring activities during stressful years than during years when agricultural yields were sufficient or surplus.

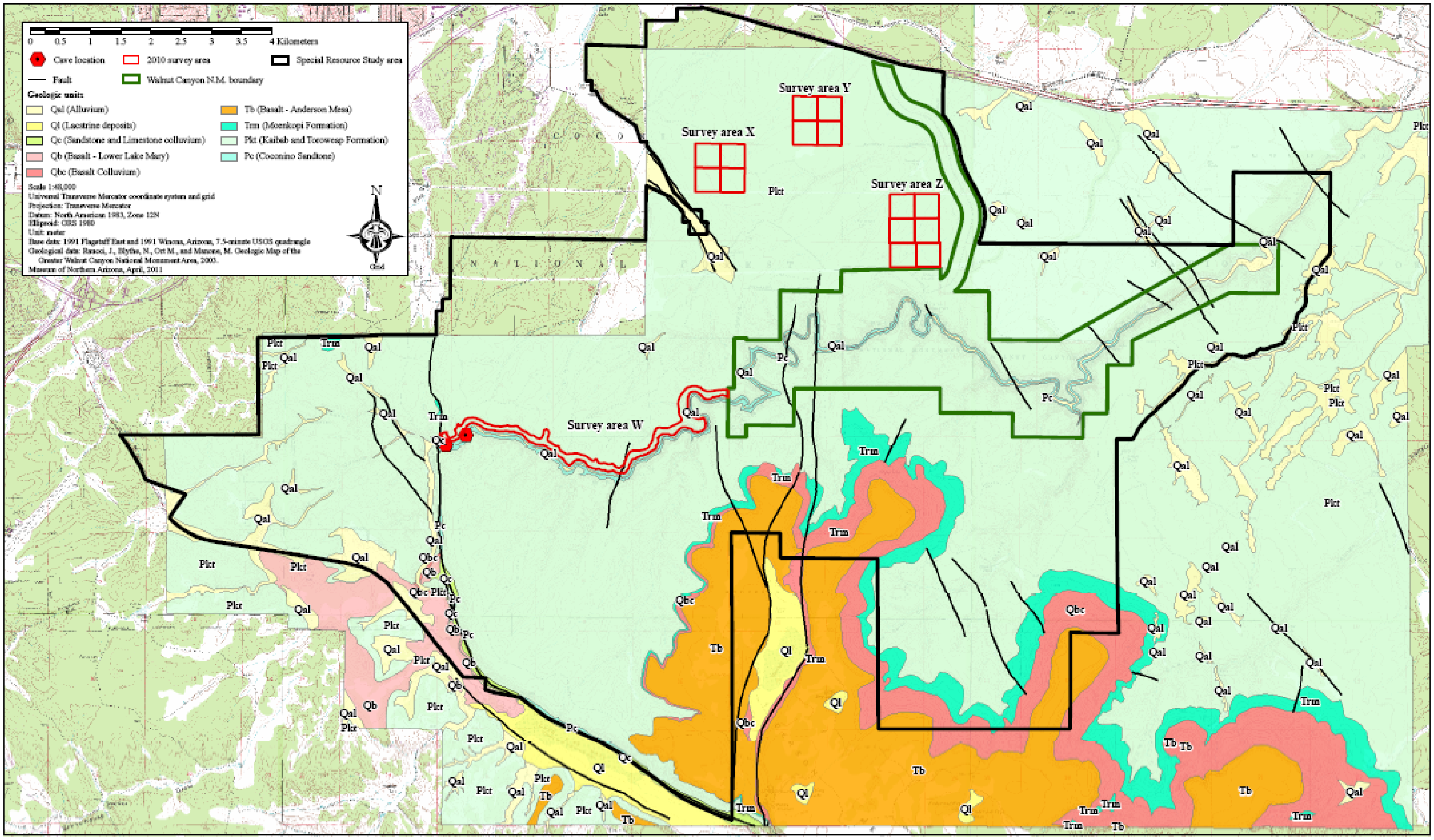

Figure 2.1. Geologic map of WACA and the surrounding area (Raucci et al. 2003)

Figure 2.2. Overview of Walnut Canyon looking downstream. The middle geologic unit is undifferentiated Kaibab and Toroweep Formation (Pkt) limestone, dolomite, and sandstone layers where the alcove sites are commonly found. The Coconino Formation (Pc) is the lowermost unit with cross-bedded eolian strata. The Kaibab Formation (Pk) limestone and dolomite form the canyon rim.

Figure 2.3a. Upper photograph illustrates the three parts of an alcove: resistant floor, less resistant alcove area, and resistant roof. Figure 2.3b. The lower photograph shows the wall of a cultural feature abutting the alcove wall.

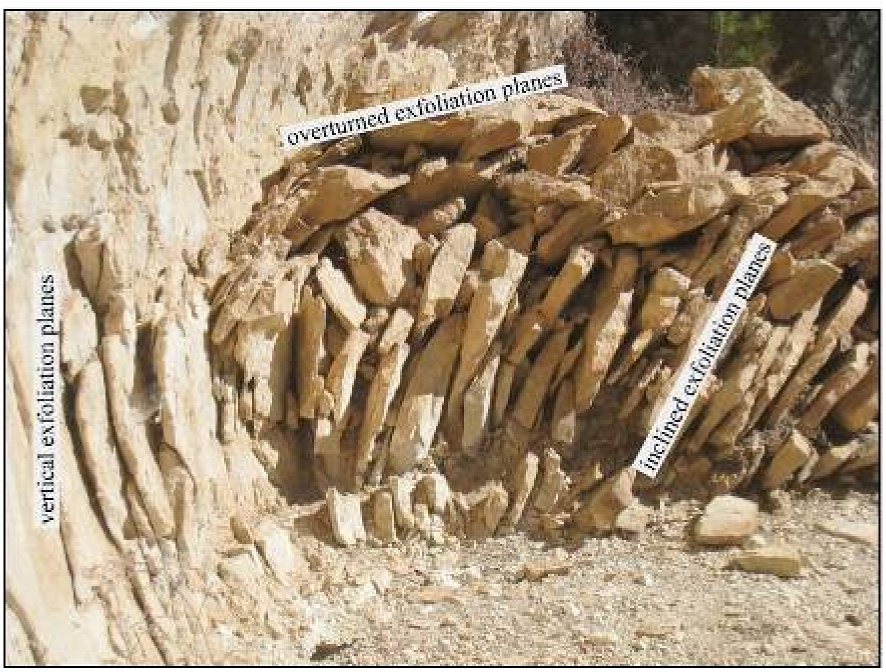

Figure 2.4a. Upper photograph shows the three parts of an alcove and the weathering of the alcove wall between resistant layers. Figure 2.4b. The lower photograph is a close-up of the weathering alcove wall. Exfoliation along vertical planes of the less resistant layer is an important weathering process. The vertical exfoliation planes become inclined and eventually rotate to a horizontal orientation.

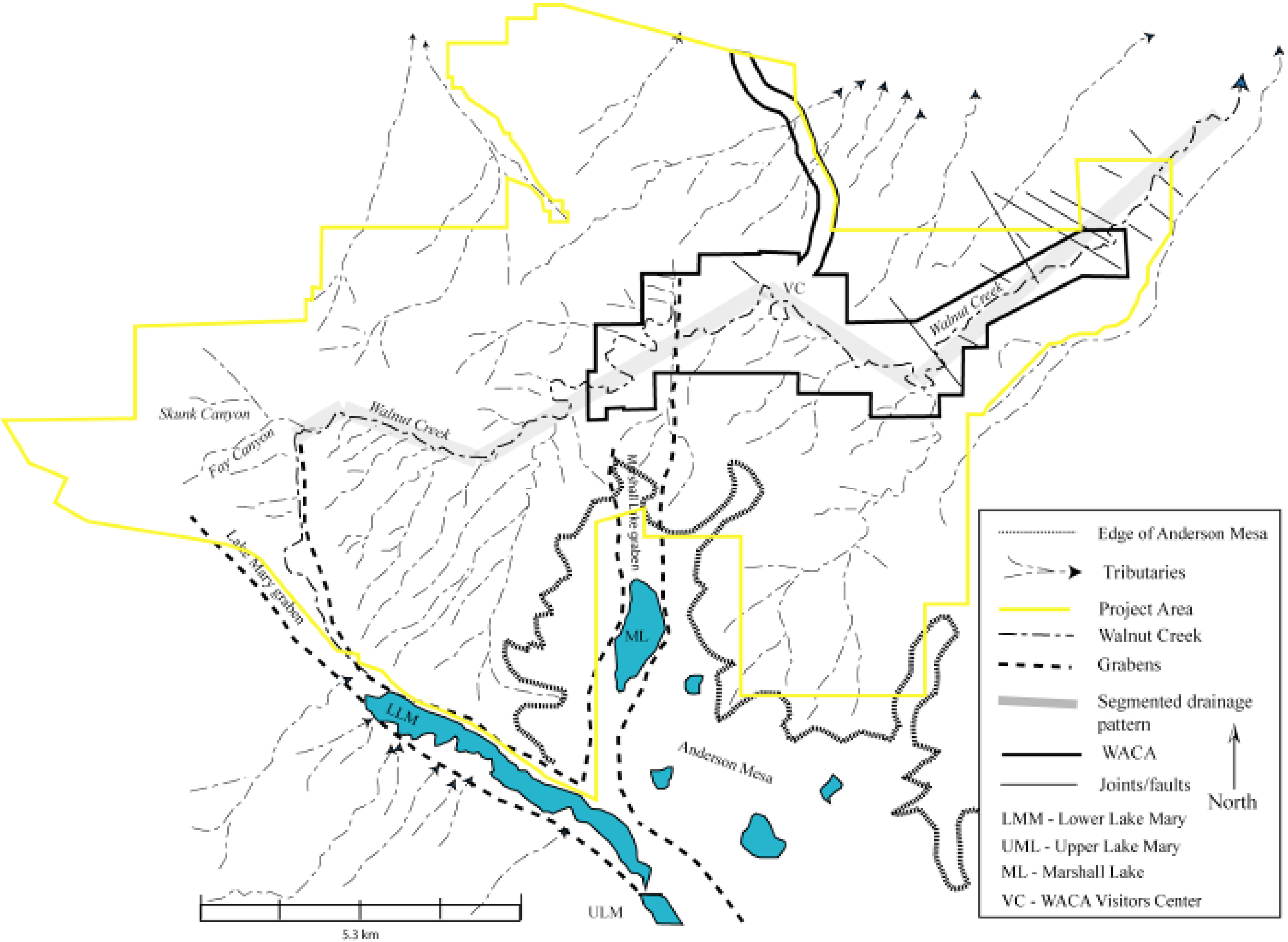

Figure 2.5. Sketch map showing drainages, grabens, jointing pattern and other physiographic features related to the WACA Special Resources Study Area (blue areas are lakes).

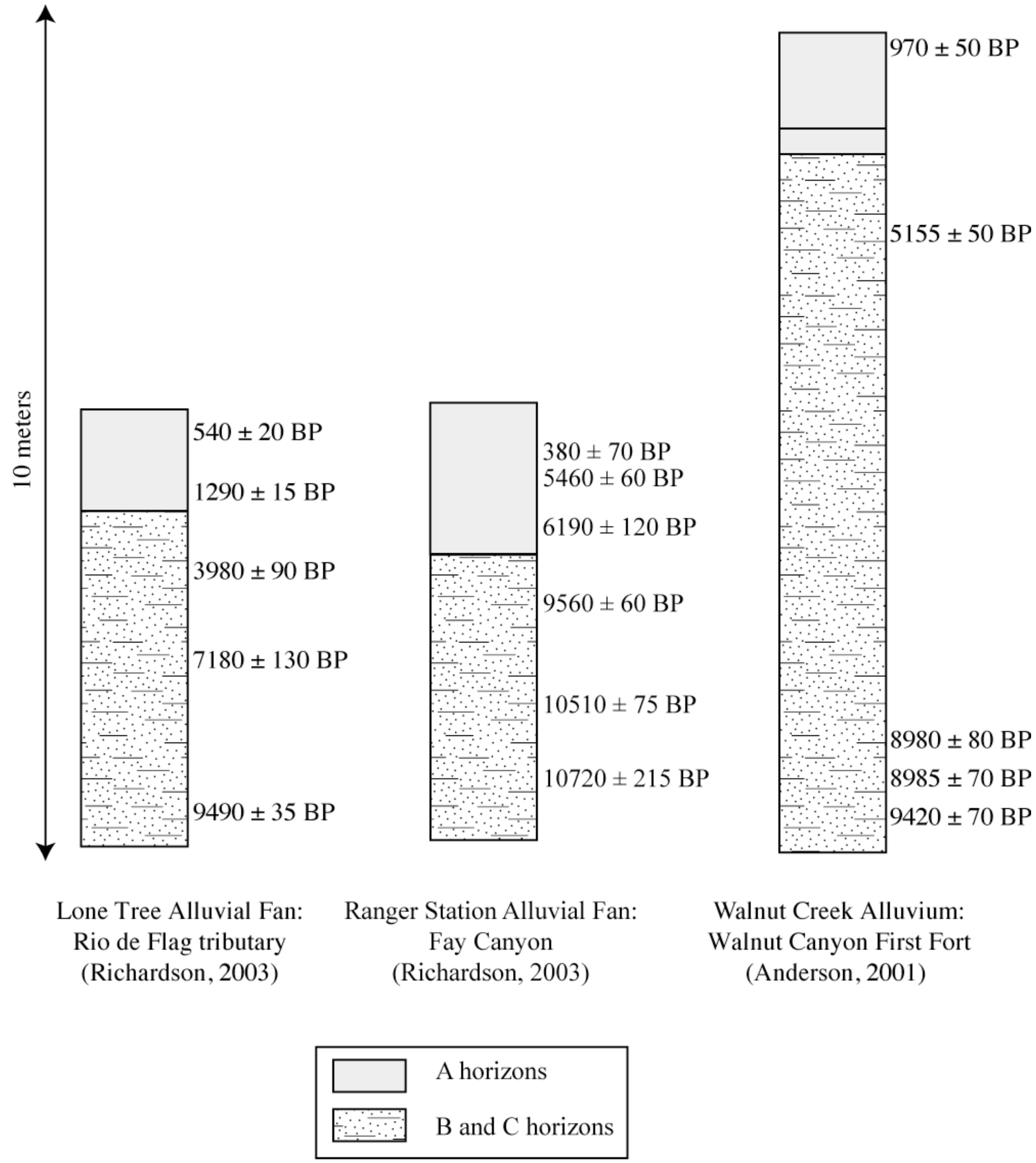

Figure 2.6. Schematic stratigraphic profiles of Hololcene deposits in and near the Walnut Creek drainage area. The distribution of the radiocarbon ages are used to derive a model of landscape changes and interpretation of the archaic period sites.

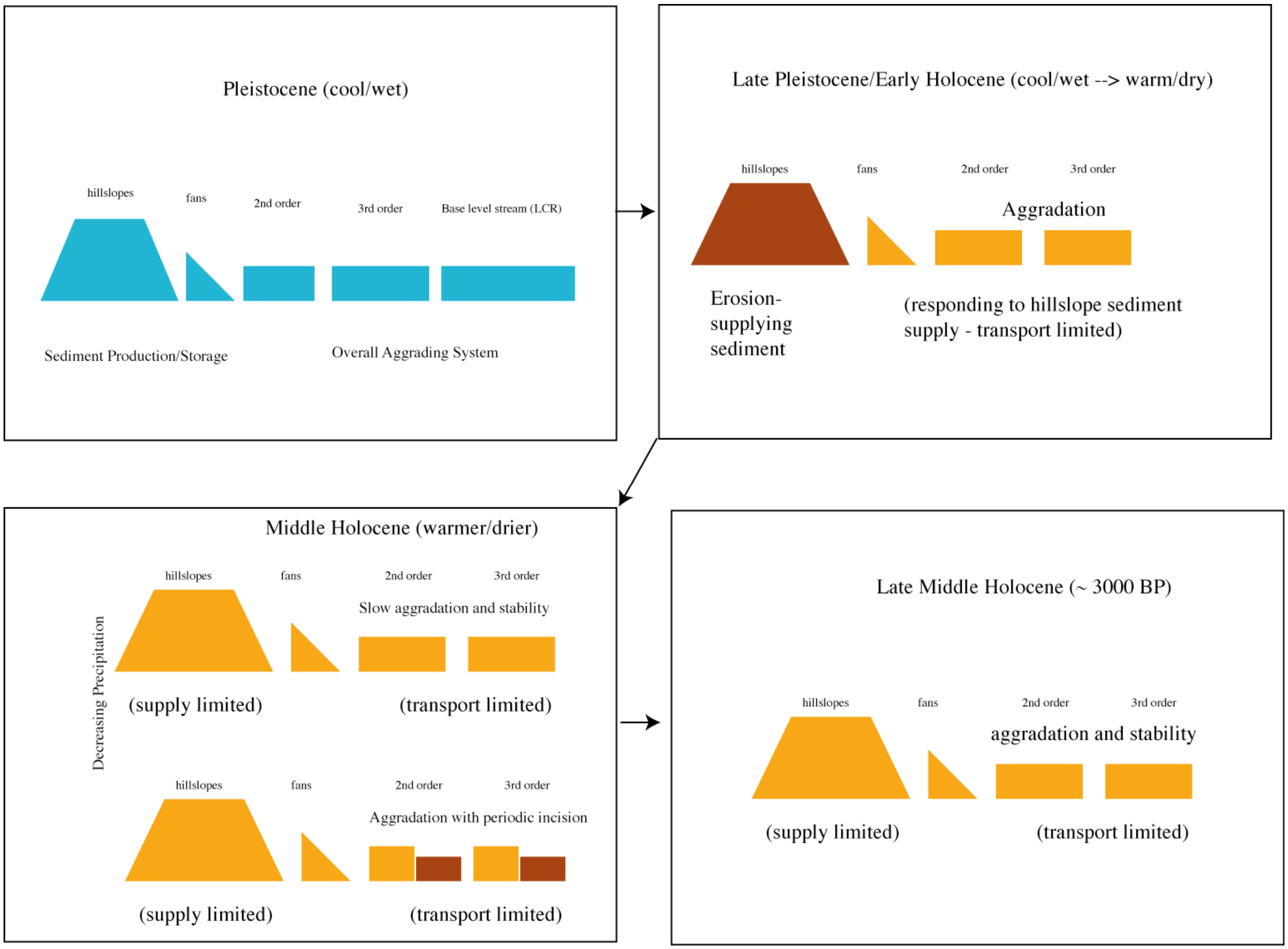

Figure 2.7. Holocene landscape model for the WACA area.

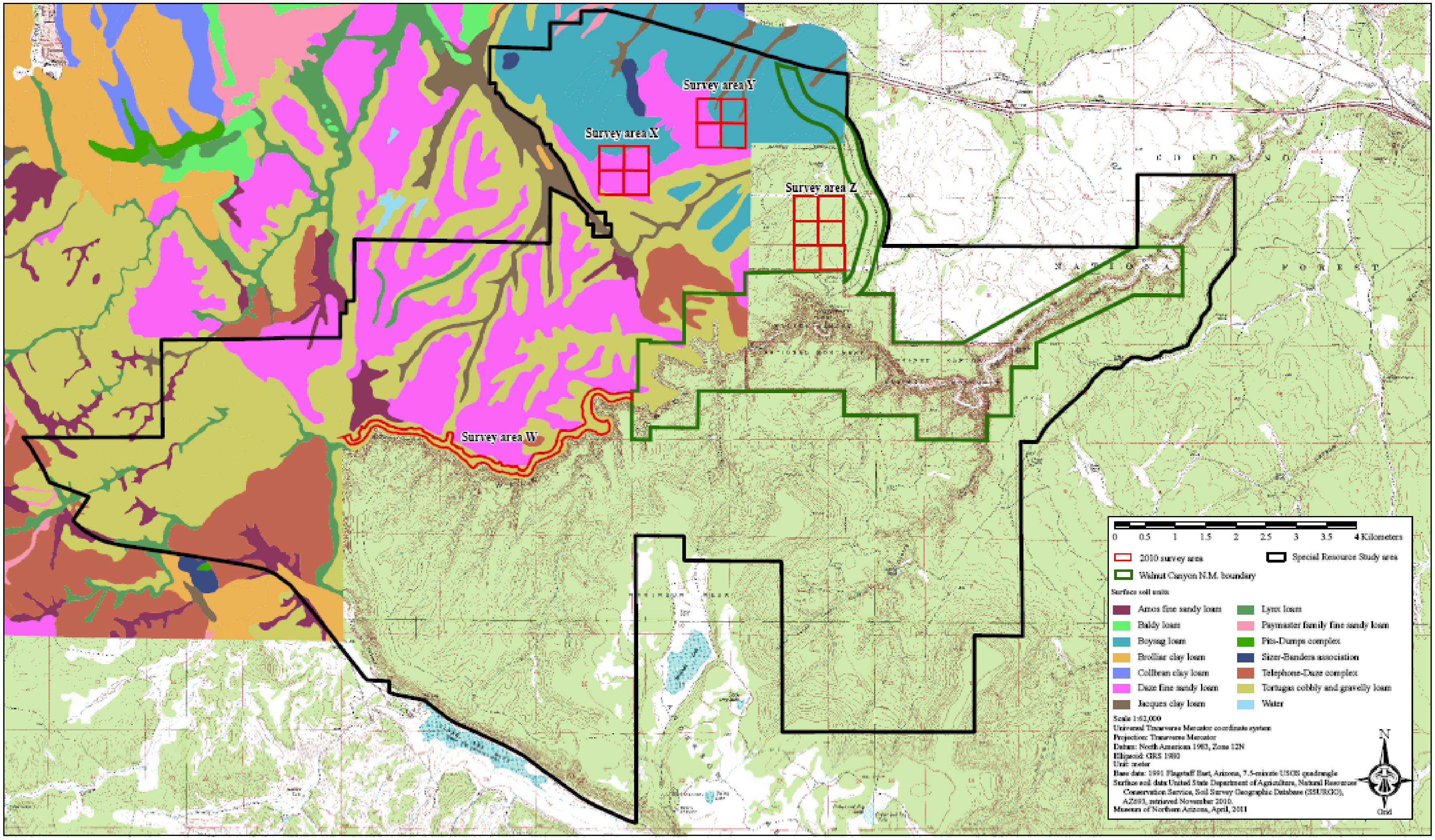

Figure 2.8. Soil map of the WACA and surrounding area.

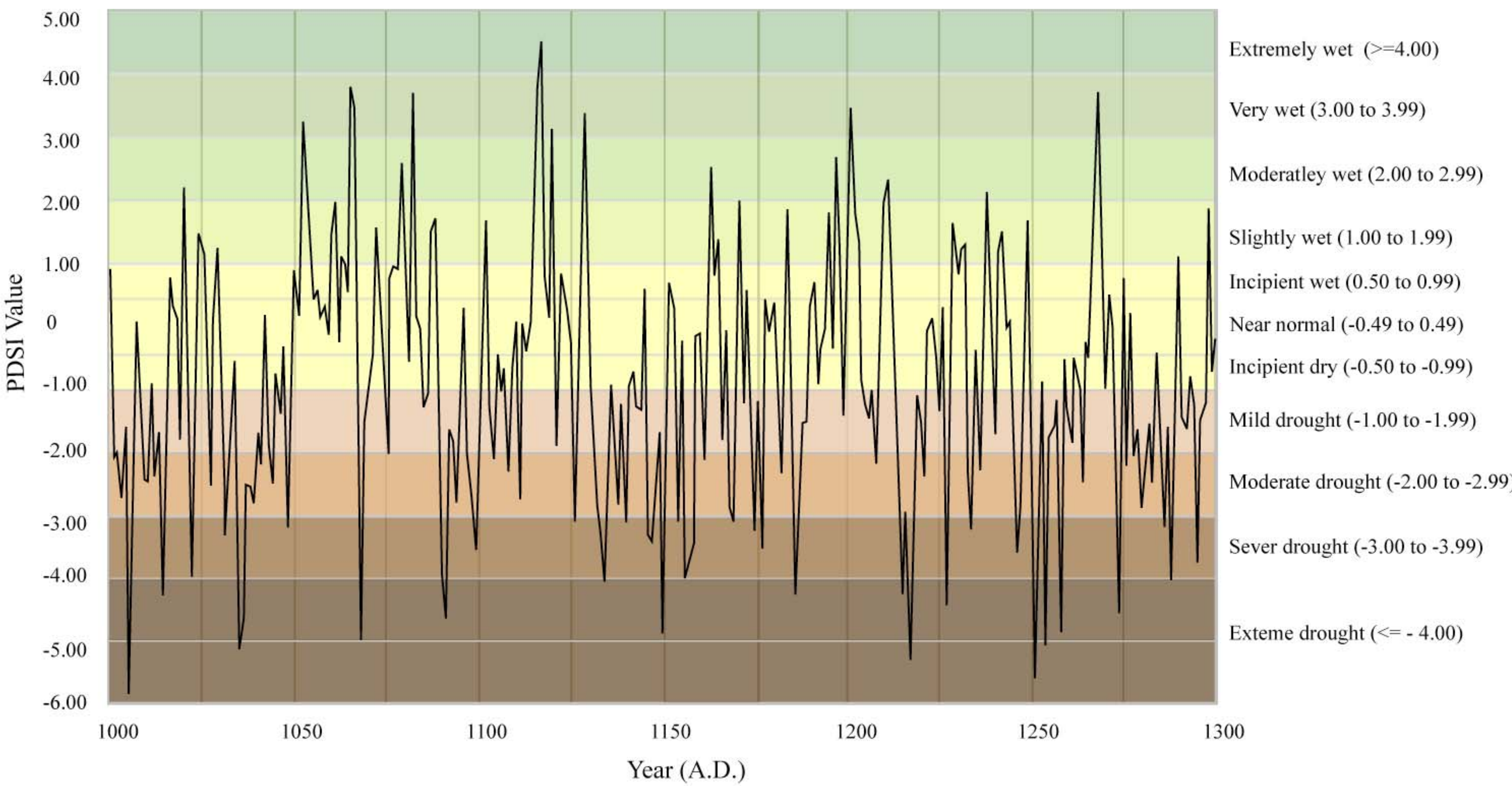

Figure 2.9. PDSI values for the years AD 1000 – 1300. Conditions of wet or dry indicated on right. Data from Cook et al., 2003.

Table 2.1. Compilation of radiocarbon ages associated with Holocene deposits in the Walnut Creek area.

Location	Sample ID	Beta Lab ID	13-C	Conventional age (BP)	Calibrated BP	Source
WACA First Fort	WCRC1-2-9/14/98 Trench 1	127041	-22.8	100 ± 60	AD1890/1905	Hereford, unpublished data
WACA First Fort	WCRCT2-1-9/14/98	127042	-23.7	8410 ± 70	9420 ± 70	Hereford, unpublished data
WACA First Fort	WCRCT2-2-9/9/98	127043	-23.7	8090 ± 80	8980 ± 80	Hereford, unpublished data
WACA First Fort	WCRCT2-3-9/9/98	127044	-23.4	8110 ± 70	8985 ± 70	Hereford, unpublished data
WACA First Fort	WCRC1-1-9/14/98	127568	-22.2	1090 ± 50	970 ± 50	Hereford, unpublished data
WACA First Fort	WCRC2-Pit4-9/9/98	127569	-22.1	4520 ± 50	5280 ± 50 5155 ± 50 5145 ± 50	Anderson, 2001
Fay Canyon	RS21	176082	-25.4	340 ± 40	380 ± 70	Richardson, 2003
Fay Canyon	RS94	176083	-23.4	4680 ± 40	5460 ± 60	Richardson, 2003
Fay Canyon	RS 120-130	173822	-24.1	5370 ± 50	6190 ± 120	Richardson, 2003
Fay Canyon	RS 170-180	176084	-24.0	8620 ± 40	9560 ± 60	Richardson, 2003
Fay Canyon	RS 230-240	173823	-24.9	9300 ± 60	10510 ± 75	Richardson, 2003
Fay Canyon	RS 290-300	173824	-23.3	9500 ± 60	10720 ± 215	Richardson, 2003
Rio de Flag trib.	LT 28	176081	-22.9	500 ± 40	540 ± 20	Richardson, 2003
Rio de Flag trib.	LT 71	173817	-22.6	1380 ± 40	1290 ± 15	Richardson, 2003
Rio de Flag trib.	LT 119	173818	-22.7	3660 ± 50	3980 ± 90	Richardson, 2003
Rio de Flag trib.	LT 140-150	173819	-23.0	6230 ± 50	7180 ± 130	Richardson, 2003
Rio de Flag trib.	LT 330-340	173820	-25.2	8450 ± 60	9490 ± 35	Richardson, 2003

Table 2.2. Soil classification, series, and characteristics in the WACA area.

Soil Series	Class	Pedon	R or Cr Desc.	Use and Veg	Discussion
Amos clay loam; fine sandy loam	Fine, mixed, superactive, mesic Typic Haplustalfs	A1/ B21t/B22t/B3t/ C1r/ C2r	C2r--50 to 56 inches; stratified shale, siltstone and calcareous sandstone with broken colors of yellowish red (5YR 5/6), yellowish red (5YR 5/6) moist; moderate medium and thick platy structure; hard to extremely hard, extremely firm, strongly effervescent; moderately alkaline (pH 8.2)	These soils are used for the production of timber and for grazing of livestock. Vegetation is mainly ponderosa pine, Gambel oak, alligator juniper with an understory of western wheat, junegrass, mountain and spike muhly and Arizona fescue.	The Amos series consists of deep, well drained soils that formed in material weathered from shale, siltstone and calcareous sandstone. These soils are on rolling uplands. The mean annual precipitation is about 19 inches and the mean annual air temperature is about 51 degrees F.
Bandera gravelly loam	Ashy-skeletal over fragmental or cindery, mixed, frigid Vitrandic Haplustolls	A1/ AC/ C1 C2		Used mostly for grazing, some recreation, and wildlife. Ponderosa pine, Gambel oak, juniper, mountain muhly, bluegrama, squirreltail, and mullein are the principal plants	The Bandera series consists of moderately deep to cinders, somewhat excessively drained, moderately permeable soils formed in cinder deposits. Bamac soils are on cone or crater landscapes. Slopes range from 0 to 50 percent. Mean annual precipitation is about 19 inches and the mean annual temperature is about 41 degrees F
Boysag gravelly loam	Clayey, mixed, superactive, mesic Lithic Ustic Haplargids	A/ Bt1 /Bt2/Bk/ R	fractured limestone	Used primarily for livestock grazing and wildlife habitat. Vegetation consists of blue grama, winterfat, galleta, desert needlegrass, New Mexico feathergrass, and needleandthread.	The Boysag series consists of shallow, well drained soils on plateaus and mesas. These soils formed in alluvium and eolian deposits from calcareous sandstone and limestone. Slopes range from 0 to 8 percent slopes. The mean annual precipitation is about 12 inches and the mean annual air temperature is about 52 degrees F.
Baldy cobbly fine sandy loam	Coarse-loamy, mixed, superactive, nonacid Typic Cryorthents	A/ C1/ C2/ C3 /C4/		Used for the production of timber and wildlife with some grazing to livestock. Vegetation consists of Douglas fir, Engleman spruce, ponderosa pine, white pine and aspen, with an understory of mountain muhly, mountain brome, mountain June grass and Sitanian	The Baldy series consists of deep, well drained, moderately rapid to rapid permeable soils formed in materials from rhyolite and andesite with some influence from basalt and ash on mountain slopes. Slopes range from 8 to 65 percent. Mean annual temperature is about 41 degrees F., and the average annual precipitation is about 35 inches.

Daze gravelly loam	Clayey, mixed, superactive, mesic Aridic Lithic Argiustolls	A1/ A2/ Bt1/ Bt2 /2R	fractured chert, dolomitic limestone	Grazing and wildlife habitat. Native vegetation is blue grama, fourwing saltbush, rabbitbrush, pine dropseed, little seed ricegrass, algerita, cliffrose and scattered juniper and turbinella oak.	The Daze series consists of shallow, well drained soils that formed in alluvium from pyroclastics over chert, dolomitic limestone and calcareous sandstone. Daze soils are on hillslopes and have slopes of 2 to 30 percent. The mean annual precipitation is about 13 inches and the mean annual temperature is about 52 degrees F.
Jacques clay loam	Fine, mixed, superactive, mesic Cumulic Haplustolls	A1/ A2 /C1/ C2		Used for livestock grazing and wildlife habitat. Vegetation consists of blue grama, sand dropseed, galleta, ring muhlenbergia, rabbitbrush, and some scattered juniper.	The Jacques series consists of very deep, well drained soils on alluvial fans, stream terraces and flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 5 percent. The mean annual precipitation is about 16 inches. The mean annual air temperature is about 50 degrees F.
Sizer gravelly silt loam	Fine-loamy over fragmental, mixed, superactive, frigid Vitrandic Argiustolls	Oi/ A1/ A2/ Bt1/ C	18 to 60 inches; gray (10YR 5/1) and brown (7.5YR 4/4) cinders or very gravelly sandy loam; massive; loose, nonsticky and nonplastic; noneffervescent	These soils are used for the production of timber and for the grazing of livestock. Vegetation consists of ponderosa pine, spruce, fir and quaking aspen, with some Arizona fescue, mountain muhly, pine dropseed and Kentucky bluegrass.	The Sizer series consists of very deep, well drained soils that formed on side slopes of cinder cones and at the base of cinder cones. The mean annual precipitation is about 27 inches and the mean annual temperature is about 43 F. Slopes range are 2 to 50 percent.
Telephone very cobbly sandy loam	Loamy-skeletal, mixed, superactive, nonacid, mesic Lithic Ustorthents	A /C/ 2R	17 to 20 inches; light gray (10YR 7/2) sandstone	These soils are used chiefly for the production of timber and grazing. Vegetation is mainly ponderosa pine, manzanita, Gambel oak, juniper, snakeweed and June grass.	The Telephone series is a member of the loamy-skeletal, mixed, nonacid, mesic family of Lithic Ustorthents. Typically, Telephone soils have light brownish gray very cobbly sandy loam A1 horizons and light gray very cobbly light sandy loam C horizons over hard bedrock at depths of about 17 inches.
Tortugas very stony loam	Loamy-skeletal, carbonatic, mesic Aridic Lithic Haplustolls	A/ R	9 inches; pinkish gray (5YR 6/2), dark grayish brown (10YR 4/2) and very pale brown (10YR 8/3) dense extremely hard limestone.	These soils are used for livestock grazing. Vegetation is cliffrose, juniper, cacti snakeweed, whitethorn, blue, black, and sideoats grama, chamiza, and annual forbs and grasses.	The Tortugas series consists of very shallow and shallow, well drained, moderately rapid permeable soils formed from limestone, calcareous sandstone and shale on gently rolling ridges to very steep hills. Slopes are 0 to 75 percent. The mean annual precipitation is about 18 inches and the mean annual air temperature is about 47 degrees F.

Table 2.3. Summary of soil types and survey units.

Argiustolls	Daze gravelly loam – Sizer gravelly silt loam	Daze - Most of Unit X; just less than half of Unit Y; most of Unit W (north side of Walnut Canyon).
Cryorthents	Baldy cobbly fine sandy loam	
Ustorthents	Telephone very cobbly sandy loam	
Haplargids	Boysag gravelly loam –	Boysag - more than half of Unit Y.
Haplustalfs	Amos clay loam; fine sandy loam	

Table 2.4. Walnut Canyon temperature data (1910-2010)

	Monthly Average Temps (°F)			Daily Extremes (°F)				Monthly Extremes (°F)			
Month	Max.	Min.	Mean	High	Date	Low	Date	High	Year	High Mean	Year
January	44.6	18.9	31.8	64	30/2003	-6	31/2008	37.9	2003	26.8	2008
February	47.2	22.2	34.7	65	18/2004	-3	05/2008	36.7	2006	32.8	2004
March	55.8	27.6	41.7	79	17/2007	8	14/2006	46.9	2004	38.2	2006
April	61.5	32.3	46.9	82	29/2007	19	19/2007	49.7	2007	44	2003
May	72.8	41.8	57.3	92	28/2003	22	01/2010	61	2009	52	2008
June	82.1	49.1	65.6	96	24/2006	30	19/1975	68.9	2007	61.7	2005
July	87.6	57.1	72.4	101	10/2003	38	01/2004	75.1	2003	70.4	1976
August	82.1	54.1	68.1	95	01/1972	40	08/2009	70.1	2008	66.1	2004
September	77.8	45.9	61.8	92	09/1977	29	22/2004	64.2	2010	58	2006
October	66.7	33.5	50.1	83	05/1975	14	24/1975	56	2003	43.6	1910
November	56.2	26.9	41.6	78	04/2009	7	30/2004	45.7	2007	37.5	1911
December	45	18.6	31.8	67	09/1910	-7	28/2003	36	1910	27.3	2009
Annual	65	35.7	50.3	101	07/10/2003	-7	12/28/2003	51.5	2007	49.9	2008
Winter	45.6	19.9	32.7	67	01/09/1910	-7	12/28/2003	35.1	2006	29.7	2008
Spring	63.4	33.9	48.7	92	05/28/2003	8	03/14/2006	50.8	2007	46.1	2010
Summer	83.9	53.4	68.7	101	07/10/2003	30	06/19/1975	71	2007	66.9	2005
Fall	66.9	35.4	51.2	92	09/09/1977	7	11/30/2004	53.2	2007	49.3	2004

Data from:
http://www.wrcc.dri.edu/index.html

Table 5. Walnut Canyon precipitation data (1910-2010).

	Precipitation (in)							Total Snowfall (in)		
Month	Mean	High	Year	Low	Year	1 Day Max	Year	Mean	High	Year
January	1.72	6.95	2005	0	1972	2.75	22/2010	11.5	52	2001
February	1.54	6.45	1993	0	1967	2.72	20/1993	10.8	32.5	1990
March	1.71	5.94	1970	0	1972	2.05	01/1970	11.6	57.8	1970
April	1	4.08	1965	0	1989	1.21	21/1985	4	35	1999
May	0.63	3.77	1992	0	1963	1.21	08/1976	0.6	12	1951
June	0.43	3.38	1955	0	1951	3.05	13/1955	0	0	1951
July	2.36	5.87	1998	0	1993	2.41	30/2006	0	0	1951
August	2.73	8.71	1986	0.16	2009	4.05	13/1987	0	0	1951
September	1.74	5.76	1958	0	1956	1.91	23/1983	0	0	1951
October	1.31	9.58	1972	0	1952	2.25	07/1972	1.3	14	1971
November	1.28	5.33	1985	0	1911	2.22	01/1987	4.4	27	1952
December	1.67	8.29	1967	0	1976	3.01	19/1967	10.7	91.3	1967
Annual	18.12	26.91	1965	9.5	1956	4.05	08/13/1987	54.9	115.1	1967
Winter	4.93	16.23	1993	0.18	2006	3.01	12/19/1967	33	98.8	1968
Spring	3.34	8.52	1965	0.71	1972	2.05	03/01/1970	16.2	64.9	1970
Summer	5.52	12.19	1986	1.78	1962	4.05	08/13/1987	0	0	1951
Fall	4.32	12.44	1972	0.38	1956	2.25	10/07/1972	5.7	27	1952

Data from: http://www.wrcc.dri.edu/index.html

Table 2.6. Snowfall totals for Walnut Canton 1950 – 2010.

Year	Snowfall (inches)	Year	Snowfall (inches)
1950-51	69.5	1980-81	6
1951-52	87.8	1981-82	10.1
1952-53	57	1982-83	14.5
1953-54	62.5	1983-84	0
1954-55	0	1984-85	43
1955-56	0	1985-86	65.3
1956-57	4	1986-87	92.3
1957-58	6.5	1987-88	63.5
1958-59	29	1988-89	54.5
1959-60	46.8	1989-90	77
1960-61	54.8	1990-91	80.4
1961-62	90.5	1991-92	88.5
1962-63	1	1992-93	98
1963-64	41	1993-94	65.5
1964-65	31	1994-95	68.7
1965-66	41.5	1995-96	32.7
1966-67	46.8	1996-97	103.5
1967-68	127.1	1997-98	90.2
1968-69	80	1998-99	50.5
1969-70	73	1999-00	48
1970-71	41.6	2000-01	90.7
1971-72	40.3	2001-02	20.5
1972-73	129	2002-03	34.5
1973-74	24.5	2003-04	27.9
1974-75	40.6	2004-05	63.2
1975-76	30	2005-06	16.3
1976-77	14	2006-07	22.3
1977-78	0	2007-08	51.6
1978-79	35.6	2008-09	62.3
1979-80	29.4	2009-10	100

Table 2.7. PDSI values by year.

Year	Reconn	Rank	Year	Reconn	Rank	Year	Reconn	Rank
1000	0.89	55	1048	-3.20	264	1096	0.34	76
1001	-2.06	219	1049	-0.90	149	1097	-2.13	221
1002	-1.99	216	1050	0.91	52	1098	-2.70	246
1003	-2.73	247	1051	0.15	90	1099	-3.57	277
1004	-1.56	195	1052	3.28	9	1100	-1.49	187
1005	-5.84	301	1053	2.07	18	1101	0.32	78
1006	-3.11	261	1054	1.18	43	1102	1.68	28
1007	0.08	95	1055	0.44	73	1103	-1.29	175
1008	-1.03	160	1056	0.56	69	1104	-2.13	224
1009	-2.46	236	1057	0.14	91	1105	-0.45	131
1010	-2.48	237	1058	0.32	79	1106	-1.03	161
1011	-0.91	150	1059	-0.16	114	1107	-0.66	140
1012	-2.38	233	1060	1.40	35	1108	-2.31	231
1013	-1.66	202	1061	2.00	19	1109	-0.93	153
1014	-4.26	288	1062	-0.27	118	1110	0.06	97
1015	-0.96	157	1063	1.11	47	1111	-2.74	248
1016	0.77	62	1064	0.53	71	1112	0.03	100
1017	0.31	82	1065	3.79	2	1113	-0.42	127
1018	0.12	93	1066	3.48	7	1114	0.06	98
1019	-1.78	209	1067	-3.43	273	1115	1.61	30
1020	2.21	16	1068	-4.96	296	1116	3.72	5
1021	-0.18	115	1069	-1.51	190	1117	4.53	1
1022	-3.97	282	1070	-0.94	154	1118	0.90	54
1023	-1.51	189	1071	-0.45	130	1119	0.13	92
1024	1.46	34	1072	1.57	31	1120	3.13	10
1025	1.14	45	1073	-0.05	105	1121	-1.89	215
1026	-0.51	135	1074	-0.94	155	1122	0.84	56
1027	-2.52	242	1075	-2.07	220	1123	0.62	67
1028	0.29	83	1076	0.79	61	1124	0.27	85
1029	1.26	41	1077	0.93	49	1125	-0.27	119
1030	-0.36	123	1078	0.92	50	1126	-3.13	263
1031	-3.31	271	1079	2.61	12	1127	-1.40	182
1032	-2.53	243	1080	0.91	53	1128	0.66	66
1033	-1.18	168	1081	-0.57	138	1129	3.38	8
1034	-0.52	136	1082	3.72	4	1130	-0.28	121
1035	-5.11	298	1083	0.19	88	1131	-1.77	205
1036	-4.65	293	1084	-0.04	104	1132	-2.84	255
1037	-2.51	240	1085	-1.33	178	1133	-3.28	269
1038	-2.54	244	1086	-1.07	164	1134	-4.08	286
1039	-2.83	252	1087	1.52	32	1135	-2.75	249
1040	-1.70	203	1088	1.72	26	1136	-0.89	147
1041	-2.21	226	1089	-0.59	139	1137	-1.77	206
1042	0.17	89	1090	-3.85	281	1138	-2.84	254
1043	-1.88	214	1091	-4.63	292	1139	-1.21	169
1044	-2.49	239	1092	-1.62	197	1140	-3.10	259
1045	-0.73	143	1093	-1.82	212	1141	-0.89	148
1046	-1.39	181	1094	-2.83	253	1142	-0.68	141
1047	-0.28	122	1095	-0.93	151	1143	-1.28	174

Table 2.7. PDSI values by year (continued).

Year	Reconn	Rank		Year	Reconn	Rank		Year	Reconn	Rank
1144	-1.36	180		1192	-0.93	152		1240	-1.74	204
1145	0.60	68		1193	-0.37	125		1241	1.16	44
1146	-3.33	272		1194	-0.07	107		1242	1.49	33
1147	-3.45	275		1195	1.80	24		1243	-0.03	103
1148	-2.46	235		1196	-0.38	126		1244	0.07	96
1149	-1.64	200		1197	2.67	11		1245	-1.78	208
1150	-4.88	295		1198	0.83	58		1246	-3.64	278
1151	-3.29	270		1199	-1.43	184		1247	-2.80	250
1152	0.69	65		1200	2.39	14		1248	0.26	86
1153	0.28	84		1201	3.49	6		1249	1.71	27
1154	-3.10	260		1202	1.77	25		1250	-1.32	177
1155	-0.23	117		1203	1.28	38		1251	-5.59	300
1156	-4.00	283		1204	-0.81	145		1252	-3.27	268
1157	-3.70	279		1205	-1.23	172		1253	-0.88	146
1158	-3.44	274		1206	-1.48	186		1254	-5.06	297
1159	-0.14	113		1207	-1.04	162		1255	-1.77	207
1160	-0.11	111		1208	-2.19	225		1256	-1.63	198
1161	-2.13	222		1209	0.31	80		1257	-1.17	166
1162	0.83	57		1210	1.88	21		1258	-4.86	294
1163	2.52	13		1211	2.33	15		1259	-0.53	137
1164	0.80	59		1212	0.92	51		1260	-1.43	183
1165	1.38	36		1213	-0.95	156		1261	-1.85	213
1166	-1.82	210		1214	-2.82	251		1262	-0.51	133
1167	-0.07	108		1215	-4.25	287		1263	-1.04	163
1168	-2.89	257		1216	-2.95	258		1264	-2.48	238
1169	-3.12	262		1217	-5.33	299		1265	-0.27	120
1170	-0.49	132		1218	-4.08	285		1266	-0.51	134
1171	1.97	20		1219	-1.10	165		1267	1.27	40
1172	-1.23	171		1220	-1.56	194		1268	3.74	3
1173	0.55	70		1221	-2.39	234		1269	0.95	48
1174	-1.82	211		1222	-0.07	109		1270	-1.00	158
1175	-3.26	267		1223	0.10	94		1271	0.53	72
1176	-1.17	167		1224	-0.43	128		1272	0.02	101
1177	-3.53	276		1225	-1.35	179		1273	-2.05	218
1178	0.41	74		1226	0.31	81		1274	-4.57	291
1179	-0.12	112		1227	-4.42	290		1275	0.77	63
1180	0.38	75		1228	-0.02	102		1276	-2.21	227
1181	-1.01	159		1229	1.62	29		1277	0.23	87
1182	-2.33	232		1230	0.79	60		1278	-2.04	217
1183	-0.06	106		1231	1.24	42		1279	-1.64	199
1184	1.83	23		1232	1.28	39		1280	-2.87	256
1185	-0.07	110		1233	-2.26	229		1281	-2.13	223
1186	-4.29	289		1234	-3.24	266		1282	-1.54	193
1187	-2.61	245		1235	-0.37	124		1283	-2.52	241
1188	-1.53	192		1236	-2.29	230		1284	-0.45	129
1189	-1.53	191		1237	0.04	99		1285	-2.23	228
1190	0.32	77		1238	2.10	17		1286	-3.21	265
1191	0.69	64		1239	1.28	37		1287	-1.60	196

Table 2.7. PDSI values by year (continued).

Year	Reconn	Rank
1288	-4.07	284
1289	-1.32	176
1290	1.12	46
1291	-1.46	185
1292	-1.65	201
1293	-0.80	144
1294	-1.24	173
1295	-3.75	280
1296	-1.50	188
1297	-1.22	170
1298	1.87	22
1299	-0.71	142
1300	-0.21	116

Table 2.8. PDSI values by ranking.

Year	Recon	Rank	Year	Recon	Rank	Year	Recon	Rank
1117	4.53	1	1000	0.89	55	1222	-0.07	109
1065	3.79	2	1122	0.84	56	1185	-0.07	110
1268	3.74	3	1162	0.83	57	1160	-0.11	111
1082	3.72	4	1198	0.83	58	1179	-0.12	112
1116	3.72	5	1164	0.80	59	1159	-0.14	113
1201	3.49	6	1230	0.79	60	1059	-0.16	114
1066	3.48	7	1076	0.79	61	1021	-0.18	115
1129	3.38	8	1016	0.77	62	1300	-0.21	116
1052	3.28	9	1275	0.77	63	1155	-0.23	117
1120	3.13	10	1191	0.69	64	1062	-0.27	118
1197	2.67	11	1152	0.69	65	1125	-0.27	119
1079	2.61	12	1128	0.66	66	1265	-0.27	120
1163	2.52	13	1123	0.62	67	1130	-0.28	121
1200	2.39	14	1145	0.60	68	1047	-0.28	122
1211	2.33	15	1056	0.56	69	1030	-0.36	123
1020	2.21	16	1173	0.55	70	1235	-0.37	124
1238	2.10	17	1064	0.53	71	1193	-0.37	125
1053	2.07	18	1271	0.53	72	1196	-0.38	126
1061	2.00	19	1055	0.44	73	1113	-0.42	127
1171	1.97	20	1178	0.41	74	1224	-0.43	128
1210	1.88	21	1180	0.38	75	1284	-0.45	129
1298	1.87	22	1096	0.34	76	1071	-0.45	130
1184	1.83	23	1190	0.32	77	1105	-0.45	131
1195	1.80	24	1101	0.32	78	1170	-0.49	132
1202	1.77	25	1058	0.32	79	1262	-0.51	133
1088	1.72	26	1209	0.31	80	1266	-0.51	134
1249	1.71	27	1226	0.31	81	1026	-0.51	135
1102	1.68	28	1017	0.31	82	1034	-0.52	136
1229	1.62	29	1028	0.29	83	1259	-0.53	137
1115	1.61	30	1153	0.28	84	1081	-0.57	138
1072	1.57	31	1124	0.27	85	1089	-0.59	139
1087	1.52	32	1248	0.26	86	1107	-0.66	140
1242	1.49	33	1277	0.23	87	1142	-0.68	141
1024	1.46	34	1083	0.19	88	1299	-0.71	142
1060	1.40	35	1042	0.17	89	1045	-0.73	143
1165	1.38	36	1051	0.15	90	1293	-0.80	144
1239	1.28	37	1057	0.14	91	1204	-0.81	145
1203	1.28	38	1119	0.13	92	1253	-0.88	146
1232	1.28	39	1018	0.12	93	1136	-0.89	147
1267	1.27	40	1223	0.10	94	1141	-0.89	148
1029	1.26	41	1007	0.08	95	1049	-0.90	149
1231	1.24	42	1244	0.07	96	1011	-0.91	150
1054	1.18	43	1110	0.06	97	1095	-0.93	151
1241	1.16	44	1114	0.06	98	1192	-0.93	152
1025	1.14	45	1237	0.04	99	1109	-0.93	153
1290	1.12	46	1112	0.03	100	1070	-0.94	154
1063	1.11	47	1272	0.02	101	1074	-0.94	155
1269	0.95	48	1228	-0.02	102	1213	-0.95	156
1077	0.93	49	1243	-0.03	103	1015	-0.96	157
1078	0.92	50	1084	-0.04	104	1270	-1.00	158
1212	0.92	51	1073	-0.05	105	1181	-1.01	159
1050	0.91	52	1183	-0.06	106	1008	-1.03	160
1080	0.91	53	1194	-0.07	107	1106	-1.03	161
1118	0.90	54	1167	-0.07	108	1207	-1.04	162

Table 2.8. PDSI values by ranking (continued).

Year	Recon	Rank	Year	Recon	Rank	Year	Recon	Rank
1263	-1.04	163	1278	-2.04	217	1031	-3.31	271
1086	-1.07	164	1273	-2.05	218	1146	-3.33	272
1219	-1.10	165	1001	-2.06	219	1067	-3.43	273
1257	-1.17	166	1075	-2.07	220	1158	-3.44	274
1176	-1.17	167	1097	-2.13	221	1147	-3.45	275
1033	-1.18	168	1161	-2.13	222	1177	-3.53	276
1139	-1.21	169	1281	-2.13	223	1099	-3.57	277
1297	-1.22	170	1104	-2.13	224	1246	-3.64	278
1172	-1.23	171	1208	-2.19	225	1157	-3.70	279
1205	-1.23	172	1041	-2.21	226	1295	-3.75	280
1294	-1.24	173	1276	-2.21	227	1090	-3.85	281
1143	-1.28	174	1285	-2.23	228	1022	-3.97	282
1103	-1.29	175	1233	-2.26	229	1156	-4.00	283
1289	-1.32	176	1236	-2.29	230	1288	-4.07	284
1250	-1.32	177	1108	-2.31	231	1218	-4.08	285
1085	-1.33	178	1182	-2.33	232	1134	-4.08	286
1225	-1.35	179	1012	-2.38	233	1215	-4.25	287
1144	-1.36	180	1221	-2.39	234	1014	-4.26	288
1046	-1.39	181	1148	-2.46	235	1186	-4.29	289
1127	-1.40	182	1009	-2.46	236	1227	-4.42	290
1260	-1.43	183	1010	-2.48	237	1274	-4.57	291
1199	-1.43	184	1264	-2.48	238	1091	-4.63	292
1291	-1.46	185	1044	-2.49	239	1036	-4.65	293
1206	-1.48	186	1037	-2.51	240	1258	-4.86	294
1100	-1.49	187	1283	-2.52	241	1150	-4.88	295
1296	-1.50	188	1027	-2.52	242	1068	-4.96	296
1023	-1.51	189	1032	-2.53	243	1254	-5.06	297
1069	-1.51	190	1038	-2.54	244	1035	-5.11	298
1189	-1.53	191	1187	-2.61	245	1217	-5.33	299
1188	-1.53	192	1098	-2.70	246	1251	-5.59	300
1282	-1.54	193	1003	-2.73	247	1005	-5.84	301
1220	-1.56	194	1111	-2.74	248			
1004	-1.56	195	1135	-2.75	249			
1287	-1.60	196	1247	-2.80	250			
1092	-1.62	197	1214	-2.82	251			
1256	-1.63	198	1039	-2.83	252			
1279	-1.64	199	1094	-2.83	253			
1149	-1.64	200	1138	-2.84	254			
1292	-1.65	201	1132	-2.84	255			
1013	-1.66	202	1280	-2.87	256			
1040	-1.70	203	1168	-2.89	257			
1240	-1.74	204	1216	-2.95	258			
1131	-1.77	205	1140	-3.10	259			
1137	-1.77	206	1154	-3.10	260			
1255	-1.77	207	1006	-3.11	261			
1245	-1.78	208	1169	-3.12	262			
1019	-1.78	209	1126	-3.13	263			
1166	-1.82	210	1048	-3.20	264			
1174	-1.82	211	1286	-3.21	265			
1093	-1.82	212	1234	-3.24	266			
1261	-1.85	213	1175	-3.26	267			
1043	-1.88	214	1252	-3.27	268			
1121	-1.89	215	1133	-3.28	269			
1002	-1.99	216	1151	-3.29	270			

Table 2.9. Years with high (wet) and low (dry) PDSI values.

Year (A.D.)	Top 47 moderately, very, and extremely wet periods (PDSI > 1.00)	Year (A.D.)	Top 43 severe and extreme drought periods (PDSI < -3.00)
		1005	1
		1006	41
		1035	4
		1036	9
1052	9		
1053	18		
1054	43		
1060	35		
1061	19		
1063	47		
1065	2		
1066	7		
		1067	29
		1068	6
1079	12		
1082	4		
1087	32		
1088	26		
		1090	21
		1091	10
		1099	25
1115	30		
1116	5		
1117	1		
1120	10		
		1126	39
		1133	33
		1134	16
		1140	43
		1146	30
		1147	27
		1150	7
		1151	32
		1154	42
		1156	19
		1157	23
		1158	28
1197	11		
1200	14		
1201	6		
1202	25		
1203	38		
		1215	15
		1217	3
		1218	17

Table 2.9 (cont'd). Years with high (wet) and low (dry) PDSI values.

Year (A.D.)	Top 47 moderately, very, and extremely wet periods (PDSI > 1.00)	Year (A.D.)	Top 43 severe and extreme drought periods (PDSI < 3.00)
1229	29		
1231	42		
1232	39		
1238	17		
1239	37		
1241	44		
1242	33		
		1246	24
		1251	2
		1252	34
		1254	5
		1258	8
1267	40		
1268	3		
		1286	37
		1288	18

Chapter 3: Prehistoric Previous Research and Culture History Relevant to the Walnut Canyon Study Area and Its National Significance: An Essay by David R. Wilcox

Most American archaeologists are familiar with the National Preservation Act of 1966 and its regulations (36 CFR Part 79), which defined four criteria of significance for nominating properties to the National Register of Historic Places. At issue in this report, however, is the question of national significance (36 CFR Part 65; Chapter 1), which sets up a higher bar, although the basic framework is similar. To make a case for the significance of archaeological resources, and in the case of national significance we must show evidence for exceptional significance, a discussion of previous research is a means of assembling the data and "theories, concepts and ideas " (36 CFR Part 65 a [6]) that are pertinent to the case for significance that is to be presented later in this report (see Chapter 7), once the other findings are added resulting from the fresh research undertaken by this study.

The archaeological resources of Walnut Canyon study area can be evaluated for national significance in either of three ways: (1) in their own right; (2) in relation to the resources already in the presently constituted Walnut Canyon National Monument (WACA); or (3) in relation both to WACA and to some part of the archaeology of the greater Flagstaff area. The latter two approaches, and perhaps the first, involve the concept of a district (36 CFR Part 65 a). In this chapter, data on archaeological resources in the study area that have been previously studied are presented, but most consideration is focused on a discussion that summarizes and synthesizes what is now known about the archaeology of the greater Flagstaff area, with special attention to WACA and the study area. The importance of Flagstaff area archaeology to that of the North American Southwest and even to world archaeology is shown. Such an analysis is necessary to show how a case for national significance in the particular case of the study area could be made.

Logically, such cases are scientific arguments that invoke inductive logic to infer conclusions from facts that have been documented from observations of the archaeological record. All such inferences must be understood initially as hypotheses that should be subjected to further testing by designing research to make fresh, but relevant, observations. After over 100 years of archaeological research in the greater Flagstaff region, some of these hypotheses have been well confirmed, while others should be regarded as plausible but still tentative inferences. In the end, at a given historical moment, when a judgment about national significance must be made, the current state of knowledge must be used to evaluate "what reasonably may be expected" (36 CFR Part 65 a [6]) to be true. Future research, if it establishes key facts, may indicate that a different conclusion is warranted than can be reasonably made with present knowledge. As we will show, this conundrum is present in the case of the Walnut Canyon study area and its possible national significance.

A chronicle of previous research in the study area (Appendix3.1) summarizes key events and contributions to what is currently known about its archaeology prior to the present study. In light of this information, we can see at once that quite a lot has been done and much has been learned about WACA and the study area since the late nineteenth century when serious modern interest in their prehistory began. Rather than repeat previous discussions, this chapter focuses on the larger contexts of the history of archaeology in the greater Flagstaff area in relation to both WACA and the study area, and to the archaeology of the Northern Southwest as a whole. As we do this, we will be looking to see if a case for national significance can be made from the data reviewed.

This chapter is broken up into eight sections as follows:

1. *Before Colton* is a discussion of the earliest scientific knowledge gathered about Walnut Canyon and the wider anthropological context of President Woodrow Wilson's proclamation of part of it as a National Monument in 1915--arguably the first recognition of its national significance.
2. *The Colton Legacy* produced in the fifty-plus years from 1916 to 1970 is then discussed in some detail, emphasizing the importance of their finding that all sites in the Flagstaff area are small, Colton's two theoretical models for interpreting its archaeology, and how two challenges to his chronological methods have been rebuffed.
3. *The Theoretical Significance of Fieldhouses* then shows how more detailed studies of small sites led to a credible critique of some of Dr. Colton's ideas and laid the basis for a reevaluation of Flagstaff archaeology using the concept of "subsistence-settlement systems, which, from the point of view of the National Register of Historic Places define "districts."
4. *Fieldhouses and Land Control* takes the theoretical discussion to another level, critically evaluating the models of Kohler (1992) and Stone and Downum (1999), which have made the study of Flagstaff archaeology generally significant, not only in the American Southwest but in world archaeology as well.
5. *Surplus, Polities, and Long-Distance Exchange Systems* widens the theoretical discussion from a preoccupation with environmental variables as principal explanatory factors to consider arguments that cultural factors were, if anything, much more important for understanding the historical trajectories of Flagstaff's aboriginal populations and the changing structure of their deployment on this complex landscape; WACA data are important in defining this picture.
6. *The Political Importance of Cotton* introduces a specific factor that may have become central to the organization of the political economy on the Colorado Plateau and the Southwest generally, showing how this factor could explain why the Flagstaff area was depopulated at a particular historical moment; WACA data again play a key role in these findings.
7. *Results of the MNA/NAU Archaeological Field School, 1985-1986*, on Campbell Mesa in the Walnut Canyon Study Area presents unpublished data from the study area that bears on the question of national significance.
8. A *Recommendation of a Scientific Basis for Determining the National Significance of Archaeological Sites in the Walnut Canyon Study Area* then concludes the chapter.

What results from this exercise is a scientific foundation for making a scientific assessment of the national significance of the study area's archaeology. Subsequent chapters (and Chapter 2) in this report assemble additional ideas and data that then are synthesized in Chapter 7. Beginning with an essay on the theoretical significance of fieldhouses (Wilcox 1978), and later with investigations in part of the study area (Wilcox 1986, 1987), together with my more general interest in the archaeology of the North American Southwest as a whole (Scarborough and Wilcox 1991; Gregory and Wilcox 2007; Wilcox 1978, 1986a, 1986b, 1999, 2002; Wilcox and Haas 1994; Wilcox and Holmlund 2007; Wilcox et al. 2008a, 2008b), I have been a "player" in the history of archaeology discussed above, and have not hesitated to bring critical standards to bear from that experience in evaluating what is now known and what its theoretical significance is. Drawing on that experience, this chapter is a demonstration of how the relationships of the study area's archaeology to that of both the WACA and that of the greater Flagstaff region, as well as the relationships to the archaeology of the North American Southwest, define a foundation or basis for evaluating their national significance on the three analytical levels set forth above. Findings reported in other chapters of this report add further substance and theoretical support to that basis. In light of these findings, and those presented in other chapters, Chapter 7 synthesizes these data and ideas into a comprehensive assessment of national significance.

Before Colton

The first point to make about the data assembled in Appendix 3.1 is the seminal influence of Harold Sellers Colton (1881-1970), his wife Mary-Russell Ferrell Colton (1889-1971), and members of their staff at the Museum of Northern Arizona, an institution they helped to found and then led for over five decades (Wilcox 2010). They set the scientific agenda for the study of Flagstaff archaeology in their half-century, and their legacy remains centrally important today, even though several of their ideas have not stood up well to subsequent scientific testing. A second point immediately follows: a part of the archaeology of Walnut Canyon was recognized as having what today may be called "national significance" by Presidential Proclamation (No. 1318) in 1915 by President Woodrow Wilson before the Coltons began their work in the region. What was the basis of that judgment?

Nationally directed archaeological research in the American Southwest arguably began in 1879 with 1) the establishment of the Bureau of Ethnology within the Smithsonian Institution in Washington DC; 2) the founding of the Anthropological Society of Washington (ASW), which soon initiated the journal American Anthropologist in 1888; and 3) the creation of the Archaeological Institute of America (AIA) in Boston, MA (Hinsley 1981; Wilcox and Fowler 2002). The latter group soon sent Adolph Bandelier to the Southwest, and his final report (Bandelier 1890, 1892) constitutes the first synthesis of the region's archaeology, ethnology, and ethnohistory. Although he did not visit the Flagstaff region, Bandelier ~~did~~ formulated a concept of "small house" sites that, as we shall see, is of fundamental importance in the interpretation of its archaeology. John Wesley Powell (1834-1902), the director of the Bureau of Ethnology, both dispatched researchers to the Southwest who visited and began initial studies of Walnut Canyon, and he himself also came to Flagstaff and visited the canyon, probably in company of his friends the Riordan brothers.

James Stevenson (in Powell 1887) reported in the fifth annual report of the Bureau of Ethnology that:

> The ruins about 15 miles southeast of Flagstaff are similar to those in Canon de Chelly. These ruins are extensive and are built in terraces in the side of Walnut Canon. They differ, however, from the cliff dwellings of Canon de Chelly in construction. The doors are large and extend from the ground up to a sufficient height to admit a man without stooping. The rooms are large and the walls are 2 to 4 feet thick. The fireplaces are in one corner of the room on an elevated rock, and the smoke can only escape through the door. The masonry compares favorably with any employed in the construction of the best villages in Canon de Chelly. Many objects of interest were found in the debris around and in these houses, Matting, sandals, spindle whorls, and stone implements of various kinds abound. The ruins in the vicinity of Flagstaff were ascertained to be of sufficient value to require further investigation.

Upon inquiry to the National Anthropological Archives for more detail on the Stevenson expedition, a research intern there, Whitney Hopkins, replied as follows:

Of particular interest is a letter from Stevenson to Powell dated Nov. 13th, 1883 and sent from Laguna, New Mexico, which includes Stevenson's description of the cave dwellings in Arizona that he encountered and he mentions that there are "numerous cliff villages in Walnut Canyon." He notes that he "made a hurried examination of these cliff dwellings and found them to differ in many respects from the cliff dwellings of the San Juan and Canon de Chelly. They are never built higher than one story [and] are frequently situated at different elevations. In the canon the walls are always from 2 to 4 feet thick, laid in fine-grained mortar, doors invariably opening on the ground, and are large, square and capacious. The rooms are all larger than those usually observed in cliff dwellings in other localities. One row or series of these dwellings extends along under a projecting ledge of rock for about a mile, and about 250 feet below the top of the canon, and about 600 feet above the bottom, the houses are separated by stall like rooms with thick stone walls between. The rocks of this canon are limestone quite full of fossils. In the sides of the canon are immense step like offsets, some of which project far out beyond the others, forming shelves under which the cliff people have built their houses. Among the debris in a few of the houses we found quite a number of interesting relics[;] we found a nicely made spindle whorl[,] points of deer horn drilled out at the larger end for some purpose, squash and melon seeds, sandals, drills, bone awls and knives, spoons made of the shoulder blade of some small animal, probably the Antelope, large numbers of jaw bones of Elk, Deer and Antelope, several small pointed tools made from the bones of wild turkey and some carnivorous animal, probably Lynx or Wild Cat. The whole of the spindle whorl was made with a sharp stone implement, first being charred by fire, then scraped down to the desired shape and size. The stem of the whorl is made from the stem of a straight reed. I also found fragments of a basket[,] which required excellent mechanical skill to construct, also fragments of cloth of different texture, very finely woven, similar however, to the same material found in the cliff dwellings of Canon de Chelly. We gathered up many other objects which, when put together, will help to explain much of the history of these dwellings and the people who made and occupied them. I hereby drop you these lines in hopes that Prof. [Otis Tufton] Mason [Curator of Ethnology at the National Museum] may be able to make some use of them.

Soon, Jesse Walter Fewkes (1850-1930), an archaeologist with the Bureau (beginning in 1894), visited Flagstaff and the Middle Verde Valley in search of archaeological evidence of Hopi migration legends (Fewkes 1898a, 1898b, 1900; Downum 1988; Wilcox 2010). He named a cliff dwelling in the Verde Valley “Palatki “ in the conviction that it was one of the stopping places of the group of Hopi clans who, according to Hopi oral tradition, arrived at Hopi “from the south.” He also briefly visited Walnut Canyon (Downum 1988:57), but spent more time at Old Caves, New Caves, and the Turkey Tank Caves (previously called “Cosnino Caves” by Amiel Weeks Whipple [1856]), and most of his time at the dramatically still-standing pueblos in the Black Falls area, now part of Wupatki National Monument (WUPA).

The name Cosnino is taken from the Uto-Aztecan Hopi word for the Upland Pai (Havasupi, Hualapai, Yavapai) peoples, some of whom apparently lived in the Flagstaff region during the protohistoric period into the nineteenth century, before the arrival of the A. T. & S. F. Railroad in 1882. The same Hopi word was later used by Harold Colton and his associates (Hargrave 1937, 1938; Colton 1939) to name the “Cohonina” culture, whose pottery (called “San

Francisco Mountain Gray Ware" [Colton and Hargrave 1937]) is predominant along Deadman's Wash north of Flagstaff and west to the Aubrey Cliffs, south to the Mogollon Rim, and north to the Grand Canyon (Figure 3.1) (Mc.Gregor 1951, 1967; Colton 1968; Cartledge 1979, 1986; Samples 1992; Wilcox n. d.). Through an interpreter, John Wesley Powell in the 1880s was told by descendents of the earlier Yuman-speaking Pai that the ruins in the Flagstaff region were those of their ancestors. Fewkes' idea was taken up by Harold Colton who called the makers of what he named Alameda Brown Ware the Sinagua, whom he thought were among the ancestors of the Hopi (Colton 1946; Wilcox 2010:464).

An Early Published Study of Walnut Canyon

One of the first published studies of the cliff dwellings in Walnut Canyon (Shimer and Shimer 1910) appeared in the American Anthropologist (AA), which by then was the organ of the American Anthropological Association (AAA) as well as the ASW. The editor of the AA was then Frederick Webb Hodge (1864-1956), who at that time was also the "Ethnologist in Charge" at the Bureau of American Ethnology (BAE), which Powell's Bureau had become in 1894 (Hinsley 1981; Woodbury and Woodbury 1999). Whether President Wilson consulted with Hodge or others at the BAE (such as Fewkes or William Henry Holmes [1846-1933]), I do not know—but he might have.

Because later commentators (Colton 1932a; Baldwin and Bremer 1986) do not cite the Shimers' work, it is here worthwhile resurrecting who they were and what they reported. Hervey Woodburn Shimer (1872-1965) was a Pennsylvanian who received his AB from Lafayette College in 1899 and AM in 1901; his Ph.D. came from Columbia University in 1904. He tutored in modern languages at Lafayette, 1899-1901; was an assistant paleontologist at Columbia, 1901-1903; studied at Harvard University, 1904-1905, where he also received a Ph.D.; was a non-resident lecturer in stratigraphic geology at MIT, 1903-1908, becoming assistant professor at same, 1908-1912, and associate professor in 1912. He was a full professor at his retirement in 1942 and was especially noted for his book Index Fossils of North America (New York Times, December 15, 1965, p. 39, col. 4; American Men of Science 1921:622; Geological Society of America Bulletin 77[5]:73-80). He thus was an up-and-coming geologist when he and his colleague F. H. Shimer (wife? brother?) visited Walnut Canyon to study its lithology and archaeology.

Because their account provides one of the first detailed scientific descriptions of the Walnut Canyon cliff dwellings, it seems appropriate to quote it in full, with some comments afterwards.

> It is in the cave-like groove formed by the erosion of the softer rock between two of these resistant beds that the cliff dwellings occur, the vast majority being about 150 feet from the bottom of the gorge. This long cave layer extending along the steep side of the canyon is divided into separate dwellings, usually with no connecting doors, by transverse walls built out from the back to the front of the cave.
>
> One house average size measured 15 feet in length, 10 feet in width or depth, and from 7 feet in height at the front to 4 feet at

the back. The floor was made approximately level by filling in the down-sloping front part with mortar. The front of the house is an artificial wall two feet thick built of native rocks of varying sizes joined by a yellowish-brown mortar of rather coarse sand such as is found in the bottom of the canyon. The stones are laid with a somewhat rough, perhaps accidental approximation at breaking joints and the wall is even and straight along both the inside and the outside surface. This front wall reaches from the floor to the overhanging ledge and is pierced at center by a door nine inches wide at base, which, though now broken away above, was probably originally less than five feet high. Against the roofing-ledge directly over the door is a round hole of four inches diameter, apparently a smoke outlet [see also Colton 1932b:3]. The transverse walls forming the ends of the house are similar in thickness and material to the front wall which they join at a right angle.

Only rarely was there noticed an opening leading from one house [room] directly into the adjoining. In one case such a connection was effected by a hole three feet high by two feet wide, its top being a flat piece of wood with ends embedded in the wall extending beyond it on each side.

That the fire was built in one of the back corners of the house was evidenced by the soot on the adjoining walls and roof and the presence of charred corn cobs, bones, and bits of wood. Fragments of pottery indicating vessels of many sizes and shapes from jars to platters are extremely abundant both in and about the houses, but especially on the slopes in front. These ancient tenement dwellers apparently found the narrow streets before their houses as great a convenience into which to throw waste as did the ancient Romans described by Juvenal; in either case the danger from falling pottery was probably at times very real.

The pottery is made of a coarse sandy clay. The most common ware is of a gray color with roughly geometric designs upon the outside in black; those of red and black are comparatively rare. Second in abundance is the type which the coiled structure appears on the surface, the coils being pinched down with the fingers.

Occasionally flat stones with raised sides, probably for grinding corn, are found in the dwellings. Of three such stones noted, two were of red sandstone and one of lava. Arrow heads of black obsidian and many chips of the same material were seen on the slopes before the houses.

On the cross-bedded sandstone in the base of the canyon, on the sides of a pot hole [tinaja], was seen some pictorial writing quite similar to that in the petrified forest at Adamana and at Willow Springs [north of Cameron].

> A hundred yards back from the cliff and near the end of the upper trail are the ruins of a house. These consist of blocks of stones in low lines of irregular height, usually no more than a foot, but preserving the outline of the outside and the dividing walls. No two stones in place one above the other were noticed. The house is 14 feet wide and 36 feet long, extending in a north-south direction. It is divided into two parts, each 14 by 18 feet. A pine tree 67 inches in circumference at base now stands just within the southwest corner of the house. There is not much pottery around the house, but about 50 feet northeast of it the ground is covered with may such fragments among which were noted a few arrow heads and chips of obsidian.
>
> Another house of one room about 9 by 9 feet was found about a third of a mile southwest of the forester's cabin. It is not so well preserved as the preceding, but the outlines of the walls can be made out. According to the resident forester at the canyon there are many such houses scattered over these uplands.

The Shimers' (1910) account is fascinating for several reasons. First, it is a succinct summary of the linear array of one-room deep cliff rooms grouped in alcoves along a certain stratum of eroded cliff face, with a narrow lateral pathway in front. Second, their account nicely describes several important characteristics of the artifact assemblages associated with the rooms, especially along the slope—much of which has apparently become depauperate due to illegal collecting activities since 1910. The quantities of black obsidian are particularly interesting as is the frequency of finger-impressed corrugated pottery (Tusayan Corrugated?). The presence of evidence of informal hearths in the back corners of some rooms, and the presence of grinding stones, both of red sandstone and lava, is helpful information, confirming statements made by James Stevenson and supporting the inference that some of the rooms were for habitation. The comparison to Juvenal's account of the Romans adds a nice humanistic touch indicative of their classical education, something few modern archaeologists can match.

Also of great interest is their descriptions of two houses on the north rim, both of which are what today would probably be called "fieldhouses" (see below). The reported comment by the ranger about the frequency of such structures "scattered over these uplands" demonstrates how early such an awareness had developed.

The Wider Anthropological Context

Interesting though the findings of the BAE archaeologists Shimers are (at least to archaeologists), an anthropological perspective on President Wilson's decision (Proclamation 1318) should examine the larger cultural and political context. Archaeologists were by no means the only citizens interested in the archaeology of Walnut Canyon in the late nineteenth and twentieth centuries (Stein 1986). President Wilson was a Democrat who won the hotly contested three-way race in 1912 against President William Howard Taft and ex-President Theodore Roosevelt. Arizona at that time voted Democrat and so it is most interesting to learn from Platt Cline (1994:255) that "Fred Breen, who, as forest supervisor, had stopped the looting of the ancient ruins in Walnut Canyon in 1904, and then as editor-publisher of the [Coconino] Sun beginning in 1908, led the campaign that resulted in the establishment of the Walnut Canyon National Monument in 1915." Breen, however, interestingly, was a Republican!

While there were local citizens with antiquarian interests (Timothy Allen Riordan [1858-1946], for example, became a long-term board member of the Museum of Northern Arizona when it was founded in 1928 [Wilcox 2010:510]), tourism was also a strong economic motive for interest in the Walnut Canyon cliff dwellings—and other sites, including Old Caves and New Caves. The activities of the Arizona Antiquarian Association from 1895 to 1901 had cleaned up access to the Montezuma Castle cliff dwelling in the Middle Verde Valley and probably helped build excitement for its being named one of the first National Monuments in 1906 (Protas 2002; Harmon, McManamon, and Pitcaithley 2006:288). Another vehicle for such boosterism was an illustrated essay (Pattee 1897) published in the Land of Sunshine edited by Charles Fletcher Lummis (1859-1928), that included a photograph of the cliff dwellings (Figure 3.2) and a map (Figure 3.3) showing two stagecoach routes to Walnut Canyon, complete with distances for each excursion. The proclamation in 1915 to preserve the cliff dwellings in part of Walnut Canyon, thus was also affirming what today might be called their national significance, rewarded local political support in Arizona and, at the same time, it recognized the public and educational values (and economic benefits) their preservation would entail. All of that is no less true today.

The Colton Legacy

Less than a year later, a professor of zoology at the University of Pennsylvania, Harold Sellers Colton, his wife Mary-Russell Ferrell Colton, a landscape painter and member of the Philadelphia Ten, and their two-year old son Ferrell, came to Flagstaff on their summer vacation. Shown a potsherd by their son, they famously began an archaeological survey of the region. Two years later, they promptly published a preliminary report on their survey (M-R and H. S. Colton 1918)-in a memoir of the AAA (which Colton had joined that same year)—and a theoretical interpretation of the data (Colton 1918)—in a Philadelphia geographical journal.

Two points about these first publications are of importance here. First, as the title of their Memoir plainly stated, the sites in the Flagstaff region are what Bandelier (1892) called “small houses.” That conclusion remains true today. The largest aggregated pueblos in the region are Wupatki Pueblo (about 100 rooms), Elden Pueblo (about 80 rooms) and smaller sites, most of which are less than four rooms. Even if we group together all the cliff-dwelling rooms in Walnut Canyon (which the Coltons had not yet recorded), there are only about 300, with a total momentary population estimated at about 185 people (Downum, Harper and Boston 1995; see below). Compilation of the Coalescent Communities Database of all known sites of 13 rooms or larger throughout the whole North American Southwest for the period 1200-1700 CE (note: in this chapter “CE” is used and it refers to common era or after the year zero *Anno Domini* or A.D.), (about 3000 sites) revealed that they can be classified into four sets: 13-99 rooms; 100-249 rooms; 250-999 rooms; and 1000 or more rooms (Wilcox, Gregory and Hill 2007). These comparatively defined classes establish a general standard for evaluating their sociological implications: they are interpreted to be the domains of hamlets and small, medium, and large villages, respectively (for the concept of coalescence, see Kowalewski 2006). On theoretical grounds, it is argued that in a worldwide comparative sample (Wilcox 1978; Wilshusen 1990) a village is a sociological aggregation of at least 70-100 people, or about 20 or more households. Permanent year-round settlements with fewer than 20 households are best interpreted as hamlets or homesteads/farmsteads (Wilcox 1978; Ciolek-Torrello 1983; Bostwick 1985). Smaller than that are seasonally-occupied sites that are discussed further below. For the moment, the important point is that all of the Flagstaff region's archaeological sites are <u>small houses</u>, no larger than large hamlets or small villages, as the Coltons (1918) first recognized. Even if the WACA cliff dwellings are regarded as a village (see below), it is still only a small one. Can small sites be nationally significant?

Second, in his theoretical analysis, Colton (1918) grasped the fundamental importance of the earlier seminal work in the Flagstaff region by C. Hart Merriam (1855-1942), that its biotic communities had a zonal structure along the precipitation and temperature gradients created by the San Francisco volcanic field (Merriam 1889; Merriam and Steineger 1890). From tundra at the top of the Peaks, these gradients supported successively more xeric-adapted vegetation associations, and the animal populations adapted to them. Still primarily a zoologist in 1918 (he would not join the AAA until that year), Colton (1918:58) concluded that Flagstaff's prehistoric Indian populations also had a preferred habitat: "A study of the environment of these [small house] ruins confirms the author's opinion that the pueblo Indian belongs to the Upper Sonoran Life Zone of which biota he is as much a member as the piñon or the sagebrush." Colton thus reaffirmed a central trope in the conquest of America, that Indians are part of nature living in a wilderness that Anglos were justified in turning to more productive uses (Kagan 2007; Wilcox 2011). Later he would modify these views.

First, however, to add a dynamic dimension to this interpretation, Colton (1918) turned to the data of regional weather stations and the results of pioneering tree-ring studies of California redwoods recently reported by Ellsworth Huntington (1914). He inferred that when conditions grew warmer, the human populations would have moved upslope into the ponderosa-pine zone, and when they became colder (and more cloudy) in higher elevations, they would have moved downslope into juniper woodland and even grassland zones. Looking at what was already known about ceramic chronologies, he concluded that the data then in hand supported this model (for a further discussion see Wilcox 1986c, 2010:446; Downum 1988). Though current models are more nuanced and complex, and are based on a great deal more data, Colton's (1918) seminal insights continue to be central to many attempts to explain the changing distribution and abundance of Flagstaff's prehistoric human populations (Wilson 1969; Pilles 1978, 1979, 1996b; Hevly 1979; Salzer and Dean 2007).

After World War I, during which Harold Colton worked on the U. S. Army General Staff doing intelligence work in Washington DC (under none other than Ellsworth Huntington [Colton 1970]), he and his wife began to spend every other year from 1919 in Flagstaff continuing their surveys. The field notebooks they kept (MNA Archives, MS 60) document the increasing sophistication of their methods. By 1921 they began systematically assigning "NA" numbers (NA for Northern Arizona) in a serial list. The first sites in the WACA they recorded were NA102-108 on the north rim (Appendix 3.1). A field sketch (MNA Archives, MS 60, 1921) shows what Colton called "First Fort" with two "natural tanks" in the bed of Walnut Canyon, one just below the "fort," and the other farther west. These early observations confirm an inference made many decades later about such tanks (see Downum, Harper and Boston 1995).

In 1923 Colton completed a manuscript on the survey results, but it was not published (with revisions) until nearly a decade later (Colton 1932a) as a BAE Bulletin. One of his interpretations about Walnut Canyon is of special interest here: "Halfway between Fishers Tank and Winona Station [on the A. T. & S. F. Railroad] the ancient people of the region congregated in a village." He apparently means all of the cliff-dwellings in the canyon constituted a single village, an interpretation that is confirmed by another statement: "a pueblo people [in Walnut Canyon] built a straggling village on and under certain ledges which, in a characteristic manner, erode out of the Kaibab limestone" (Colton 1932b:1). This perception of the 300+ cliff-dwelling rooms in Walnut Canyon as a single community is a significant sociological insight about their behavior that is further amplified by the graph-theoretic study of the sites in the WACA by Michael Bremer (1988).

Moving to Flagstaff in 1926, the Coltons were already involved in local efforts to establish a museum, and the Northern Arizona Society of Science and Art launched the Museum of Northern Arizona in the Woman's building on September 6, 1928 (Wilcox 2010). Supported by a donation from his mother, Colton (1970) began a program of field investigations involving excavations by Lyndon Lane Hargrave (1896-1978) and John Charles Mc.Gregor (1905-1992). When Mc.Gregor (1930; Colton 1946:105-107) discovered the black cinders of a volcanic eruption from Sunset Crater in the NA1296 pithouse and other nearby sites north of Flagstaff (in what they called "Medicine Valley" along upper Deadman's Wash), Colton was intrigued. He immediately replotted his site distributions in relation to the cinder-fall zone of that eruption. This resulted in what can be called his "black sand" model (Colton 1960; Wilcox 1986c) in which he postulated that one result of the eruption was the increased arability of areas in the more xeric edges of the pinyon-juniper woodland and grassland zones due to a mulch effect much like that he had observed in Hopi sand-dune fields (see also Hack 1942). He further postulated that a land rush to the region would then have occurred.

Concurrently, he and his staff, based on tree-ring dating of ceramic assemblages found in burned sites, were developing a tree-ring chronology of both architectural forms and ceramic types and other artifact classes, which resulted in the definition of a "culture history" for the Flagstaff region (Haury and Hargrave 1931; Hargrave 1932; Colton and Hargrave 1937; Colton 1939; see Table 3.1). Excavations by Mc.Gregor (1941) at Winona (just east of lower Walnut Creek after it exited the canyon) and Ridge Ruin (1.5 miles farther east) resulted in a more complex "black sand" model. Given his prediction of a land rush, Colton (1939, 1946) in his culture history sought to differentiate separately migrating cultural groups, which he called "foci," adapting a concept from the Midwest Taxonomic System (McKern 1939), but with the addition of temporal specificity. Thus the Winona focus was thought to indicate Hohokam populations who brought ballcourts to the region, while the Angell focus resulted from Mogollon migrants (Mc.Gregor 1941, 1965) coming contemporaneously to the region. A peaceful integration of these migrants, they also inferred, was expressed in the Padre focus and the later Elden focus. Because their chronologies showed that the Flagstaff region was depopulated by about 1300 CE, they linked that process to the rise of large pueblo sites on eastern Anderson Mesa to define the fourteenth-century Clear Creek focus. At the other end of the sequence, excavations by Bryn Mawr professor Fredericka de Laguna (1942) at the Cinder Park site north of Leupp Road (northeast of Flagstaff) led to the definition of an early Cinder Park focus, which represented the earliest appearance of agriculture in the Flagstaff region (see Table 3.1). Since then, only a trace of even earlier Paleoindian and Archaic presence has been documented in the region (Downum 1993; Neff and Spurr 2004).

An alternative cultural-historical model, more typological in its logic, but also involving temporal periods called “phases,” was proposed by Winifred and Harold Gladwin (1934). Gladwin soon initiated one of the first great controversies in Southwestern archaeology, challenging both Colton’s (1939) model and its very foundations, the A. E. Douglass method of tree-ring dating (Nash 1999). During the lull in field work caused by gas rationing during World War II, Colton (1946) marshaled all the data he had accumulated since 1916 to answer Gladwin systematically, thus producing the first comprehensive synthesis of the archaeology of the Flagstaff region. He thus established a baseline that remains essential to all subsequent inquiry (Downum 1988). However, following the suggestions of Willey and Phillips (1958), the term “phase” has now superceded that of “focus.”

The national significance of Colton’s approach to culture history was celebrated in a textbook on Southwestern archaeology written by John Mc.Gregor (1965), first for high school teachers in 1944 and published in a second edition in 1965. It became a text for courses in Southwest archaeology taught nationwide. Colton's concept of a local, distinctive population, the Sinagua, is unique in Southwestern archaeology, being an early example of what today is called "population thinking" and "cultural ecology." As a contribution to archaeological knowledge, both theoretically and methodologically, it is deserving of recognition as being nationally significant (see also Sullivan 1994).

Colton himself after World War II kept busy, publishing a summary of his ceramic methods (Colton 1953) and convening a series of seminal ceramic seminars that produced a wide scientific consensus about the Southwestern ceramic typology and chronology. David Breternitz, who was Curator of Anthropology at MNA, 1956-1959 (Wilcox 2010:516), then went back to graduate school and produced a dissertation (Breternitz 1966) that pulled together an influential synthesis of the dating of a long list of Southwestern ceramic types. Few places in the world can match the precision of Southwestern ceramic chronologies (Downum 1988).

While continuing research in the greater Flagstaff region has now refined these chronologies and typologies (Ambler 1985; Downum 1988; Fairley and Geib 1989; Sullivan, Becher and Downum 1995; Hays-Gilpin and van Hartesveldt 1998; Acord 2005), based on a better understanding of the complexities of tree-ring dating--what Dean (1978; see also Ahlstrom 1985) calls “target events” (the cultural event one wishes to date)--in the domain of ceramic classification they have carried on in the Colton tradition, “standing on his shoulders,” so to speak. A new challenge to the logic of these ceramic approaches was mounted in the 1970s and 1980s by William Longacre (1970), Fred Plog (1989) and their students. Dismissing the type concept, they advocated computer analyses of attribute data and sourcing studies, but interesting though some of these studies are (e. g. Douglas 1987), they often led to chaotic results to which temporal order could be restored only by returning to Dr. Colton’s tried-and-true methods (Downum 1988; Hays-Gilpin and van Hartesveldt 1998). Kenny Acord (2005), building on these results, recently collected new data, reanalyzed some earlier collections, and presented a comprehensive reexamination of the ceramic chronology of Walnut Canyon's archaeology. Further development of these methods is presented later in this report.

The Theoretical Significance of Fieldhouses

Passage of the federal Historic Preservation Act in 1966, and promulgations of its regulations in 1972, together with other federal and state laws, executive orders and regulations, set in motion profound changes in the way Southwestern archaeology was being conducted (Wilcox 2004). Now many federal agencies began hiring their own archaeological staffs and contracting for archaeological projects by advertising in the Federal Register. The amount of data being collected rapidly ballooned, doubling at an astonishing rate. By the middle 1970s, privately owned cultural resource management companies began out-competing universities and museums for the federal contracts. At the same time, in both academia and cultural resource management, new philosophies and methodologies for conducting archaeological research were being formulated, and whole new educational programs were invented to meet the growing labor demand for trained archaeologists (see Fowler and Cordell 2005). One result of this ferment was a new interest in small sites, many of which were being excavated and interpreted, greatly adding to their significance to an understanding of Southwestern archaeology.

Seizing the moment, Peter Pilles, the newly appointed archaeologist for the Coconino National Forest, and I (an advanced graduate student at the University of Arizona), in 1976 organized a conference on small sites in the Southwest that was soon published (Ward 1978). Richard Woodbury (1961) was the first Southwestern archaeologist, in his study of the late prehistoric agricultural landscapes of the Point of Pines region in east-central Arizona, to use the term "fieldhouses" for one- or two-room masonry sites located up to several miles from large habitation sites and associated with field areas marked by various kinds of rock alignments (terraces, linear borders, etc.). He inferred fieldhouse sites were only seasonally occupied. Unpacking Woodbury's (1961) seminal insights was the task undertaken in the 1976 "small sites" conference. Moore (1975, 1978, n. d.) and Gregory (1975) had pointed out that "single-room sites" may include shrines, playhouses, hunting lodges, gathering stations, or permanent, year-round dwellings, as well as fieldhouses in Woodbury's (1961) sense. Similarly, ramadas, brush shelters, or even multi-room structures may be functionally equivalent to many seasonally-used single or double-roomed sites: "[o]nly the storage function [inferred by Woodbury (1961)], the size of the social group, and perhaps the length of the occupation may not be comparable across these site types" (Wilcox 1978).

To restore analytical clarity to the meaning of the "fieldhouse" term, Wilcox (1978) argued we should clearly distinguish between descriptions of the archaeological record involving the classification of a series of morphological classes (Gregory 1975), and a theoretical concept in what Schiffer (1972) called "systemic context." David Clarke (1973), in his classic paper on the general structure of archaeological theory, distinguished multiple levels of systemic context: theory about what people did in the past; depositional theory about how traces (see Sullivan 1978, 2008) of that behavior becomes incorporated into the archaeological record; post-depositional theory about how those traces were affected or redistributed by subsequent cultural or natural processes; retrieval or recovery theory about the affects of sampling the archaeological record resulting from differential or incomplete survey or excavation by archaeologists (or others); analytical theory about data manipulation; and interpretative theory about how inferences are made about all the earlier theoretical domains. If that were not enough, Clarke (1973) shows that cross-cutting the above levels are the theoretical domains of archaeological logic, epistemology, and metaphysics (Figure 3.4; see also Wilcox, McGuire and Sternberg 1981:147-155; Schiffer 2002).

Supposing we accept this account of archaeological theory, it should be clear that understanding of the archaeological past is no simple exercise, and it should not surprise us that there are many differences of opinion and multiple perspectives along many philosophical dimensions about archaeological interpretation. By the same token, interpreting the results of archaeological inquiry to the general public is equally fraught with many large and small difficulties, although too often such interpretation presumes an authoritative tone that does more to mislead the general public than to dispassionately inform them. Acceptance of our own fallibility and at least a modicum of tolerance for differing interpretations seem to be the wisest pedagogical strategy (Wilcox 2005a). Or, in a phrase often heard, “more work needs to be done” to test all interpretations (on the need to test hypotheses, not simply dismiss them, see Wilcox et al. 2008a).

Returning to the discussion of the theoretical significance of fieldhouses in the functional sense of “structures used seasonally in conjunction with farming,” when this concept is applied to the archaeology of the Flagstaff region, Pilles (1978, 1979) argued that many of the masonry “small houses” found there were probably only seasonally used as fieldhouses. Therefore, he questioned the land-rush evidence marshaled by Colton (1936, 1960), arguing that those population estimates must be revised downward. In a reanalysis of the data from the Winona ballcourt site (Mc.Gregor 1941), Fish, Pilles and Fish (1980) showed that the claim for a Hohokam “migration” came down to a single pithouse and its artifact associations. Instead of a migration, they suggested that a resident Hohokam trader best accounts for the data—a pattern also seen in the Stove Canyon ballcourt site in the Point of Pines region (Neely 1974).

Migration of Kayenta Anasazi populations into the Wupatki area, however, seems well supported by results of the full-coverage survey of the Wupatki monument (Anderson 1990; see below). The size and frequency of Cohonina sites currently being documented along middle Deadmans Wash west and south of Wupatki Pueblo (cf Colton 1968; Bern Carey, personal communication 2011; see Table 3.1) likely similarly supports the proposition of a migration of Cohonina populations into that locality following the eruption of Sunset Crater (see below). Depopulation of the Sitgreaves Mountain Cohonina west of Deadmans Wash began after about 1075 CE and was complete by about 1125 CE (Samples 1992; Samples and Wilcox 1992; Christensen et al. 2006; Wilcox and Neff 2009; Wilcox n. d.). Ceramic continuity and later painted-pottery associations in the adjacent Upper Basin (south of eastern Grand Canyon) and the middle Deadmans Wash to the east strongly support the inference that these were the destinations of the Sitgreaves Cohonina populations. More work is being done to test these inferences, but a related point is also worth making: in both the Upper Basin and middle and upper Deadmans Wash there are earlier Cohonina sites dating from late Basketmaker III through early Pueblo II times (ca. 750-1050 CE). This contrasts with the migration of Kayenta populations into the grassland/juniper-woodland edge of the Flagstaff region, where there is scant evidence of such early occupation by either Cohonina or Sinagua populations (Downum and Sullivan 1990; Sullivan and Downum 1991), the Cohonina post-1050 CE were joining with their cultural cousins who likely had long been affiliated via long-distance exchange networks that brought Tusayan (Kayenta) White and Gray Ware pottery into their settlements. Bern Carey's recent work on the CNF along Deadmans Wash south of WUPA (personal communication 2011) has found the earliest Kayenta sites there on Woodhouse Mesa date to the late 1000s (see below), which is earlier than nearly all the sites documented in the WUPA (Sullivan and Downum 1991).

Numerous structures that appear to be "fieldhouses" occur in Sinagua, Cohonina, and Kayenta settlement zones. Excavations of some of them show that a sub-set of them do appear to be seasonally occupied as architectural facilities connected to farming activities (Ward 1978b; Bostwick 1985; Lambert 2006). Others, however, have much richer and more functionally diverse artifact assemblages; these sites appear to be "seasonal farmsteads" where the intensity and duration of occupation was greater than in true fieldhouses (Bostwick 1985). Others appear to be farmsteads occupied year-round (Wilcox 1986c; see below). Whether these "small house" ruins are contemporaneous with multi-room habitation sites in either the pithouse or later pueblo periods remains uncertain (Pilles 1978, 1979, 1996b). Even whether the latter pueblo sites are absolutely contemporaneous (see Dean 1978) is not clear (Pilles 1996b; but see Kamp and Whittaker 1999). The reason is that ceramic chronologies, good as they are, do not always permit resolution at a generational or intra-generational scale. This uncertainty frustrates the theoretical objective Wilcox (1978) proposed for fieldhouses (and other site classes): the definition of contemporaneous "subsistence-settlement systems" (see Streuver 1968). Inferences about such systems can still be based on patterning in settlement distributions in time and space, but uncertainty about dating means that a variety of alternative subsistence models cannot be easily dismissed. This problem is one of the chief conundrums of Flagstaff-area archaeology and affects the interpretation of sites in the Walnut Canyon study area as well.

Beginning with a paper by Vita-Vinzi and Higgs (1970), "site catchment analysis" was introduced into world archaeology and has become a way to define the extent of subsistence-settlement systems. Based on a worldwide sampling of such analyses, Varien (1999) suggests that 7 km is a good measure (or index) for defining how far pedestrian farmers will go to collect or hunt wild foods or other goods in their local environment. Similarly, Varien (1999) finds that pedestrian farmers will only go about 2 km from their houses to farm (see also Chisholm 1978). Using a "cost-surface" analysis, Varien (1999) shows how to apply these concepts to define local subsistence-settlement systems, and how larger communities can be defined using the overlap of such catchment analyses. Applying the same methods, Brett Hill has now produced related studies of a sample of over 3000 sites in the whole North American Southwest based on the Coalescent Communities Database (Wilcox, Gregory and Hill 2007). These methods can also be used in an evaluation of the territorial extent of the Walnut Canyon "village" (see below).

Already the 1950s, Sallie Pierce Van Valkenburgh (1958, 1961; see Appendix 3.1) presciently began recording small-house sites above the north rim of Walnut Canyon in the belief that they do bear some behavioral relationship to the land-use strategies of the cliff-house dwellers, and the idea persists that she was basically correct (see Appendix 3.1). Bremer's (1988) graph-theoretic study is premised on just such an assumption. While not certain, it seems significant that no data yet negates the inference of a changing series of subsistence-settlement systems linking sites in the canyon with those located above the rims. Could alternatives to this hypothesis be mere “theoretical chimeras?” (see Sullivan 1996:148)?

Supposing that there were such subsistence-settlement systems, what was the economic strategy for annual, year-to-year survival in the Flagstaff region, and Walnut Canyon in particular? High in elevation, with an arid climate, the Flagstaff region generally was a tough place to make a living. Hence Colton’s (1939, 1946) characterization of its populations as Sinagua, "without water" (in which he included what now increasingly appear to be Cohonina populations in the Deadmans Wash area in what he, however, regarded as a frontier zone [Colton 1968]). Corn crops may have failed as often (or in some periods more often) than one out of every three years (Stone and Downum 1999:117). What was a family to do? Several answers to this question have been offered that merit brief discussion here.

1. Take advantage of elevational differences along the San Francisco Peaks gradient. This was Colton’s (1918) initial concept, which is still plausible today (Pilles 1978, 1979; Dean et al. 1985; Gumerman 1988). Deployment of fieldhouses or seasonal farmsteads, or even summer farming hamlets/villages (as at Zuni in the historic period), are possible ways to implement a strategy for using the environmental gradient to good advantage. DeBoer (1976, 1980), however, has shown that this was not always done, and we might also ask what could be done if the gradient was already fully occupied?
2. Take advantage of the mosaic of micro-environments within each biotic zone. Walnut Canyon, for example, as a whole compresses the general zonation of the Flagstaff region into a small space. Vegetation on the south-facing slopes contrasts sharply with that on the north-facing slopes (Colton 1932b). Seeps and pools of water often are sites of unique species (Stevens 2004). When we add to this canyon landscape the micro-environments above the rims, which include various kinds of juniper woodlands, oak-pine associations, etc. (Bostwick 1985), it is clear that Walnut Canyon and the study area around it were places with a lot of advantages for a mosaic strategy. That there was use of areas on the north rim for farming was reported by Colton (1932b:5): “[t]he cultivated fields of these Indians [at Walnut Canyon] were in the little parks in the forest of junipers <u>to the northeast</u> of the villages, where one can often pick up remains of their broken stone hoes” (emphasis added).
3. Use a strategy of shifting cultivation, burning vegetation to supply nutrients to field patches. Deeply impressed by the book <u>Shifting Cultivation in Southeast Asia</u> by J. E. Spencer (1966), a geographer at the University of California, Berkeley, and a colleague of Carl Sauer, Wilcox (1978) argued that much of the agriculture practiced in the American Southwest was a form of shifting cultivation (see Spencer 1966:2). Kirk Bryan (1929:444) in his classic study of Southwestern dry farming and floodwater farming states that, “[t]he two types are alike in that the fields are generally isolated and frequently abandoned” (see also Beaglehole 1937:36-37). Both nutrient exhaustion and changing distributions of rainfall frequencies may induce the shifting of field locations. “In both the tropics and the Southwest, however, large amounts of land were needed if the agricultural populations were to retain their flexibility in the face of changing environment” (Wilcox 1978). Shifting field locations allows fallowing to occur, but it should also be noticed that many economic plants that spring up in “fallowed” fields could also be harvested as part of a comprehensive cropping strategy (Spencer 1966).

4. When cultigens fail, shift attention to wild foods. Michael Diehl (1997) has shown that ubiquity values in sites along U. S. 89 north of Flagstaff to the edge of the Wupatki monument support the conclusion that maize and other cultigens were the primary plant foods consumed by both Sinagua and Cohonina populations. Interestingly, however, his data also show that a wide variety of other plant foods were also probably consumed. Limited test excavations in NA324, a Walnut Canyon cliff dwelling (Downum 2000), strongly support these findings: 43 taxa of economic plants, including only five cultigens, were found, although some of the taxa were represented only by unburned specimens. The latter might have been introduced by pack rats or other animals, though human use cannot be ruled out. Other data from Flagstaff-area sites (Colton 1946; Bostwick 1985; Berlin, Salas, and Geib 1990; Kamp and Whittaker 1999) further document the attention paid to Cheno-ams, grass seed, Amaranth, acorns, pinyon nuts, juniper seeds, etc. (see also Appendix 3.1).

Alan Sullivan (e. g., 1984, 1986, 1987, 1996) has championed a proposition that Western Anasazi and Sinagua populations practiced shifting cultivation, using burning of ponderosa-forest duff or pinyon-juniper forest patches (see also Kohler 1992) to encourage the growth of denser patches of wild foods. His research in the Upper Basin over the last 25 years has produced an impressive series of sophisticated methodological studies to test his perspective, with considerable success (Sullivan, Roos and Mink 2011). However, some evidence for maize has also been found in the Upper Basin (Sullivan 1995). At present, a conservative conclusion is to agree, in part, with both Diehl (1997) and Sullivan (1996), thus postulating a mixed strategy in which the "farming" being done in connection with fieldhouses or seasonal farmsteads may well have involved much more than planting and harvesting maize or other cultigens (see Bostwick 1985). New testing of this proposition is needed.

Fieldhouses and Land Control

New insights about the role of fieldhouse in subsistence-settlement systems anywhere in the Southwest may help to define new insights about the archaeology of the greater Flagstaff region, WACA, and the study area. Robert Pruecel (1988) in a study of masonry fieldhouses on the Pajarito Plateau in northern New Mexico noticed that some of them were located surprisingly close to large masonry pueblos. Previously (see essays in Ward 1978; Woodbury 1961), it had been thought that the reason for building fieldhouses was logistical: to overcome the transportation costs of farming at a distance by temporarily moving the harvest into fieldhouse storage units before arranging to bring it back to the habitation loci. Pruecel (1988:236) explained the anomaly he observed by suggesting that fieldhouses "may have developed as a means of laying claim to especially good agricultural land. In this case, the founding of a field house may have been viewed as an overt symbol of ownership." That this inference furthered a post-modernist agenda in world archaeology at that time (see Hodder 1986) in no way reduces the value of this theoretical insight (though it does shed light on the origins of such insights).

Drawing inspiration, as he says, from the studies of Wilcox (1978) and Pruecel (1988), Timothy Kohler (1992) developed their ideas further in a fascinating study of Pueblo I settlement systems (ca. mid 800s CE) in the Dolores Valley (on the northern edge of the Mesa Verde region in southwest Colorado) that has important testable implications for the study of the archaeology of the Flagstaff region and the study area. The Dolores Valley was one of the first places in the Southwest where true (if small) villages first appeared, with villages evenly spaced about 5 km apart, something that did not happen (if just barely) in the Flagstaff region for another 300 years. Kohler (1992) argues that the small sites he infers were fieldhouses fall into two morphological classes: 1) those with few artifacts that were still being used, he suggests, in a shifting-cultivation strategy; and 2) those with much larger artifact assemblages that, he infers, should be located on the best agricultural land and that were placed there to stake a claim to it. As we have seen above, these two types of "fieldhouses" are also present in the Flagstaff region, where new tests are needed to see if their locational parameters conform to Kohler's (1992) predictions.

Finally, Kohler (1992:632) provides a general summary of why he thinks fieldhouses first appear (cf. Wilcox 1978):

> In the Mesa Verde region in general, village formation apparently had two important prerequisites. First, local populations had to be relatively dense (Orcutt et al. 1990); this entrained depletion of wild resources and agricultural intensification. Second, local agricultural production had to be generally high, but with high spatial variability within years and high temporal variability between years: this set up conditions under which households could maximize the value of their agricultural production by participating in sharing with other households (Van West and Kohler 1992). Such cooperation was better accomplished by aggregated than in dispersed settings. Therefore, the formation of villages—important in generating field houses in the first type of [shifting cultivation] model—is in part caused by the same increases in local population and increasing competition for scarce agricultural land that are the presumed antecedents of field houses in the second [land claiming] model. As effects of partly overlapping causes, aggregation and the appearance of field houses should be strongly correlated; any instances where one appeared without the other should be especially illuminating for further study.

A rather different theory about village formation built out of quite different theoretical antecedents has been elegantly postulated more recently to explain their appearance in the Flagstaff region after about 1075 CE. Stone and Downum (1999) depart from the widely influential theory of agricultural growth proposed by Ester Boserup (1965, 1981), which they generally support:

> Boserup holds that extensive cultivation is normally practiced when rural population density is low enough to allow it. Extensive cultivation tends to be satisfactory in terms of output when measured per unit area; it also tends to be favorable in total labor costs and labor <u>efficiency</u> (output:input). Ecologically, extensive cultivation tends to capitalize on the benefits of fallowing, which

> eases the work of field preparation, weeding, and fertilizing. In arid environments, extensive cultivation has the benefit of diversifying the portfolio of microenvironments that respond differentially to inter-annual variation in precipitation (Stone and Downum 1999:114; emphasis original).

Rising population density (often called population pressure) forces shortening of fallow cycles to increase "production concentrations:" "[a]chieving higher production concentrations at the cost of more work at lower efficiency is what Boserup describes as agricultural intensification" (Stone and Downum 1999:114). Cleverly, however, they examine the prior conditions that must be satisfied to apply this theory, and they argue that there are two other prior concatenations:

> At some levels of production in some agroecological contexts, production concentration can be raised without lowering efficiency: <u>lower efficiency is not necessary</u>. On the other hand, at some levels of production in some agroecological contexts, production per time and area cannot be reliably raised even with harder work and lower marginal returns: <u>lower efficiency is not sufficient</u> (Stone and Downum 1999:115; emphasis original).

Looking at the data generated by the Wupatki survey (Anderson 1990), they deny that the evidence of fieldhouse construction and landscape modification from linear borders and brush fences weighted down by spaced lines of large rocks took much labor to build. Hence, the agricultural system remained an "extensive," not an intensive, one. The landscape modifications ("improvements") they interpret as "visual claims to use-rights" and, they postulate "shared concepts of property rights" enforced by "the merging of social units into a larger and stronger unity, alliance, or polity" (cf. Kohler 1992). When the colonization of Walnut Canyon and the study area occurred, were there similar processes in play?

In the Wupatki area they postulate Cohonina and Sinagua "ethnic" polities that faced off against one another using the construction of "monumental" sites at Citadel (by the Cohonina) and Wupatki Pueblo (by the Sinagua: see Colton 1946), respectively, as dramatic symbols of each polity's land claims. A modern African case study by Stone (1997) affords a nicely reasoned analogy. While admitting that there is evidence of violence in the political context they define, they conclude that it was not well organized but was merely an occasional resort by individual initiative to "small-scale terrorism" (Stone and Downum 1999:123; see also Turner and Turner 1999).

Not discussed by Stone and Downum (1999) is the co-occurrence elsewhere in the Sinagua area of contemporaneous Elden phase large hamlets that are evenly spaced about 5-7 km apart: Old Caves, Elden, Turkey Hill, New Caves, (Lizard Man), Ridge, and Two Kivas ruins, and the Walnut Canyon "village" equally distant from many of them to the south (see Chapter 6, this report, Figure 6.3). Elsewhere, Wilcox (1996, 2002) has argued that Wupatki Pueblo is more likely a Kayenta Anasazi site (cf. Colton 1946), if the variety of Sunset Red found there is best called "Flagstaff Red," as Hargrave (1932; Colton et al. 1934) did, claiming that it had a thicker (better-made) slip and was thinned using a Kayenta-style coil-and-scrape technique (but see Colton and Hargrave 1937). No anvil stones were found at Wupatki (Stanislawski 1963), raising doubt whether Flagstaff Red should be classified as Alameda Brown Ware (the pottery of the Sinagua), which is thinned using a paddle-and-anvil method (Colton and Hargrave 1937:164-165). Downum (1988:497) found that Sunset Red/Brown, which was first produced (based on tree-ring dated contexts) in Sinagua sites by 1080 CE, is not found in well-dated sites north of Sunset Crater (and Colton's "Coconino Divide") "until much later"—after, apparently, Wupatki Pueblo was built in the middle 1100 CE (see Robinson, Harrill, and Warren 1975). More detailed analyses of the Flagstaff Red/Sunset Red contrast are needed to test my inference. Interestingly, Bern Carey's on going studies along Deadmans Wash on the CNF also have found that Sunset/Flagstaff Red is not common until after about 1150 CE (personal communication, 2011).

Downum and Sullivan (1990:5:85), in their analysis of the Wupatki monument's settlement patterns, conclude in a way that supports the position of Wilcox (2002).

> While the Walnut Canyon may have been settled primarily by people from the immediate Flagstaff area, we propose that Wupatki National Monument may have been settled largely by Kayenta Anasazi populations, originating, perhaps, from the Black Mesa area to the northeast. Portions of this area were depopulated at approximately the same time that the Monument population experienced its greatest rate of increase (Powell et al. 1983:233). A post A. D. 1130 Kayenta influx for Wupatki National Monument was also identified by Smith (1952:94, 173) at sites in the Big Hawk Valley.

The predominance of Tusayan Gray and White Wares across the monument, especially after 1130 CE (Downum and Sullivan 1990) support their view, as does the similar pattern on Woodhouse Mesa south of Wupatki (Bern Carey, personal communication, 2011; however, he has found Kayenta sites that date in the previous period, and NA2110 [AR 03-04-02-123], as seen in MNA collections, also has a good late 1000s to 1200s date).

Another supporting fact can also now be pointed out. Hooten and Ort (2007) have recently prepared an isopach map that shows the estimated depth of cinders in an area created by the Sunset Crater eruption; it demonstrates that, between the Cohonina/Kayenta populations on the north along Deadmans Wash and the Sinagua on the south and east, there was a 450 square km no-man's-land where no agriculture was possible where the cinders were over 10 cm deep (Waring 2007) (see Figure 3.5). Interestingly, however, if Wupatki Pueblo truly was a Kayenta site, the overall political argument made by Stone and Downum (1999) is not adversely affected. The findings by Hooten and Ort (2007) and Waring (2007), however, define a new perspective on the environmental context of movements by Sinagua populations to colonize new areas south (to Walnut Canyon and Winona) and east (to Angell) following their exclusion from the cinder-covered no-man's land. What are the political implications of these movements?

Surplus, Polities, and Long-Distance Exchange Systems

Without quibbling about how much labor is indicated by masonry fieldhouses and field borders (cf. Wilcox 1978), we should question one claim made by Stone and Downum (1999): that no increase in what they call "production concentrations" occurred. It has long been assumed (if not well demonstrated) that many of the rooms in twelfth and early thirteenth century pueblos in the Flagstaff region were dedicated to storage. Downum, Harper and Boston (1995) show that a large number of the 300+ cliff dwelling rooms in Walnut Canyon were purely storerooms (lacking hearths or other indication of habitation). Even after taking into account Pilles' (1978, 1979) strictures about not using counts of fieldhouses to estimate population, the excellent dataset from the Wupatki survey still arguably indicates that there was a significant population increase there several generations after the eruption of Sunset Crater (Downum and Sullivan 1990; Sullivan and Downum 1991). So too, the data now being documented by Bern Carey (Table 3.1) south and west of Wupatki along middle Deadmans Wash strengthens this inference, although he also finds that already in the late 1000s there was significant Kayenta occupation on Woodhouse Mesa, with Kayenta sites advancing westward later (personal communication, 2011). What is not so well documented is the possibility that the storage space/person also increased. That needs to be studied because significant theoretical issues hinge on it. For example, if it is true, the changes in agricultural growth seen in the Flagstaff region after 1075 CE may have resulted in greater "production concentrations" after all, and a shift to a still fairly simple strategy of intensification.

If the storage space/person is significantly larger, which it may well be by the early Elden phase ca. 1125-1175 CE, then the likelihood that a "fund of power" (Wolf 1982; Lightfoot and Plog 1984) controlled by local political leaders was established would be greatly enhanced (see discussion in Berlin, Salas, and Geib 1990). Such funds of power (or a system of "staple finance" as it is also called [Earle 2001; Kantner 2003]) can be created by civic-ceremonial leaders successfully demanding surplus from followers, thus requiring that more production be achieved if the followers are not to starve. Greater production can be brought about by increasing field sizes, increasing the efficiency of cropping systems, or in other ways. Increasing land control would also be desirable, something the leaders could help to assure through military force by organizing warrior societies (a form of sodality). The concentration of "stored surplus" in a few relatively large settlements would potentially contribute several new social and political benefits: 1) stored food would offset the danger of crop failures, at least for those with access to it; 2) the stored food could be used to sponsor feasting and ceremonies with neighboring communities, perhaps including some at considerable distances; 3) the stored food could pay for exotic items used to legitimate the ceremonial roles of local leaders; and 4) stored food could sponsor the manufacture of valuable trade goods that could be exchanged over long-distances for other goods deemed more important. Cotton textiles would be one example, whose production may have required a certain amount of skill and even specialized knowledge (see Webster 2007).

That relatively large quantities of exotic valuables (sometimes called "preciosities" by archaeologists [but see Kowalewski 1996]) came into the Flagstaff area after about 1075 CE cannot be doubted. In the Joseph Babbitt collection of burial assemblages excavated by him in the Flagstaff region (Wilcox 2006; see also Goertze and Mills 2001), and given to the Museum of Northern Arizona in 1982 by his daughter Dr. Rayma Sharber and her brother Joseph Jr. to be used for educational purposes, there are 29,676 pieces of shell (Biehl 1996:29, 676). Prior to the eruption of Sunset Crater, long thought to date to about 1064 CE (Smiley 1958; Downum 1988;

but see Elson et al. 2011), hardly any shell is known from the Flagstaff region, but by 1075 CE it increases dramatically (Wigglesworth 1985). While there is some reason to suspect that some of the public ritual facilities known as "ballcourts" found in the Flagstaff region date before the eruption (Morales 1994), most date afterwards (and I think all of them may do so [Wilcox 2002]; see Figure 3.6). The ceremonies centered on the ballcourts are a possible mechanism for the movement of valuables into the region through ritual exchanges (Wilcox 1987a; see also Abbott, Smith and Gallaga 2007).

Other types of civic or ceremonial spaces also are found in the Flagstaff area. One Elden- and Turkey Hill-phase site, Elden Pueblo, had two large rectangular "community rooms" (Plog 1989:279), although one was added later than the other and the first was partitioned into four rooms (Peter Pilles, personal communication 2011). Other Elden- or Turkey Hill-phase sites had plazas or community rooms; some had ballcourts nearby and some did not. The nearby ballcourts, however, may have ceased to be used as ceremonial facilities before the Elden phase (Mc.Gregor 1941:88; Morales 1994; cf. Wilcox 1986c, 2002). That hypothesis, at least, would explain their peculiar distribution and their absence near many later big sites (Elden Pueblo, Turkey Hill Pueblo, Two Kivas Pueblo, Walnut Canyon).

Even the Walnut Canyon cliff-dwellings, although no ballcourt is associated with them, did receive at least some valuables, including turquoise and shell (Rixey and Voll 1962; see Appendix 3.1). Harper (1993) has suggested that the sites inferred to be "forts" by Colton (1932, 1946) are instead community gathering places where ceremonies could have been staged and ritual exchanges made. We note in passing that they might also have been defendable places fairly called forts; what I have called their "choreographic structure," in a report to the National Park Service about Hohokam ballcourts (Wilcox and Sternberg 1983), needs to be examined. How many people could have congregated at the so-called "forts," and how effective could their arrangements have been to protect those gathered there? Was there an early warning system of lookouts associated with them (see Wilcox, Robertson and Wood 2001a; Wilcox et al. 2008b; Wilcox and Neff 2009). All these questions should be studied at Cohonina and Kayenta sites along Deadmans Wash as well. Both the so-called "monumental" sites of Citadel and Wupatki (Stone and Downum 1999) have many characteristics that would make them quite defendable, including height advantages, being out of easy bow shot, and having line-of-sight relationships with nearby sites (which would have facilitated signaling and early warning).

At Wupatki Pueblo (Stanislawski 1963; Hargrave 1970; see also Creel and McKusick 1994) 41 scarlet macaw skeletons were found, more than are known from any other site north of Mexico. There are also relatively numerous copper bells, shell, turquoise, and cotton textiles (Stanislawski 1963; Folb 1996). No well dated macaws are known in the Hohokam area (the center of the ballcourt distribution [Wilcox and Sternberg 1983]) in the period 1075-1250 CE, and the 28 bells from Snaketown (Gladwin et al. 1937) are a different type than found at other Southwestern sites (Vokes and Gregory 2007). To explain the unique fact that the valuables that are known in the Hohokam ballcourt network (shell, turquoise, cotton textiles) and the Chacoan world (macaws, copper bells), Wilcox (see Wilcox, Keller and Ortiz 2000; Wilcox 2002; Wilcox et al. 2008b) has proposed the "Wupatki nexus" theory in which he postulates that the Mimbres populations were middlemen in the transfer of valuables from West Mexico (macaws and copper bells—and maybe textiles and other goods: see Webster 2007a; Crown and Hurst 2009) to the

Chacoan world and hence to Wupatki Pueblo. A key body of evidence supporting the idea of Mimbres pilgrimages to the Gulf of California near Guaymas, Sonora, is the presence of marine-fish designs on Mimbres pots (Jett and Moyle 1986), the assemblage of which occurs in the middle Gulf, near Guaymas. Confirming this theory is the presence of relatively large quantities of Nassarius shells--which are restricted to the middle Gulf--in Mimbres, Chaco, and Flagstaff sites (see Biehl 1996), but not in Hohokam sites at this time (Wilcox 2002; Vokes and Gregory 2007; Wilcox et al. ~~2008a~~ 2008a).

Ceremonies associated with Chaco-style circular great kivas are a likely context for the transfer of the Chacoan valuables to Wupatki. The "amphitheater" at Wupatki is a late form of unroofed great kiva, and it dates in an interval of the early or middle 1100s when an extensive network of circular great kivas extends westward from Chacoan sites in the Puerco of the West to Heber, AZ, and then jumps to Flagstaff (Herr 2001; Wilcox 2005b: see Figure 3.7). The Wupatki ballcourt (Lindsay 1965), the only one built using stone masonry (after the Kayenta fashion), had a piece of Flagstaff Black-on-white under one of its walls, pointing toward its Elden-phase temporal dating. However, one wonders if it was a piece informally being called "So-staff," intermediate between Sosi and Flagstaff Black-on-white--which would mean a date before 1150 CE or the Elden phase (as Mc.Gregor 1941:88 thought).

At Ridge Ruin, a Sinagua site dating to the late 1100s and early 1200s CE, Mc.Gregor (1943) found what he called the "magician" burial, which had an incredibly rich artifact assemblage associated with it, including a scarlet macaw burial on the deliberately cinder-covered floor above the burial pit (Hargrave 1970). The shell assemblage found with this burial included a whole Haliotis shell with the holes plugged with asphaltum, which must have come from the Chumash area of Santa Barbara on the Pacific coast, as did other shell, including the Dentalium used in his cap. A map of the Ridge Ruin site (Figure 3.8; Wilcox 2010:Fig. 71) shows that Room 13, where the burial was interred in the middle of the floor, is on the north end of the north-south axis of the site, a possibly ceremonially significant place. When Mc.Gregor (1943) showed parts of the burial assemblage to Hopi elders from three of the Hopi mesas, he was given different interpretations at each, but they seemed to agree that this large man was a ceremonial leader for several key ceremonies, and that he was probably a war leader, the head of a warrior society. Even most of the 400 projectile points found with the magician (possibly part of quivers) are made in Hohokam styles on non-obsidian cherts that may come from elsewhere than the Flagstaff area (Sliva 1997). The 25 whole vessels associated with him indicate a ceramic date of about 1200 CE.

The Ridge Ruin "magician" had a distinctive pointed cap made from black stone beads and Dentalium shells that came from the Pacific (Mc.Gregor 1943). He also had a sword wand, and the Hopi thought he was a "sword swallower," which is why Mc.Gregor (1943) called him a "magician." The pointed cap is similar to one seen in Pottery Mound murals found in central New Mexico and dating to the fifteenth or sixteenth centuries, and in Pueblo IV rock art in the northern Rio Grande region (Schaafsma 2000, 2007). These data are possibly evidence that the kind of warrior role the Ridge Ruin magician played endured for centuries afterward; the cap is also pictured in the Awat'ovi murals found on Antelope Mesa at Hopi, and it persisted even into the nineteenth century of Hopi memory (see Schaafsma 2000). In her excellent discussion of warfare iconography in the Rio Grande, Schaafsma (2000:52-53, 123-127) interprets the figures with pointed caps as war gods. She also reports sword swallowers pictured in association with war iconography (Schaafsma 2000:123) and she (pp. 168-169) goes on to say that

> [t]he sword, arrow, and stick swallowers in the rock art represent other probable war-related prehistoric orders with contemporary analogues. In the last [nineteenth] century at Hopi and Zuni, those enacting extraordinary swallowing feats were members of particular orders. At Hopi the Stick Swallowers were an order of the Momtcit War Society, with the war-affiliated Spider and Kookop clans owning the paraphernalia.

Warfare in the Flagstaff region during the Elden phase may thus have been a lot more organized than Stone and Downum (1999) were willing to admit.

John Hohmann in the published version (Hohmann 1983) of his master's thesis, which he completed at Northern Arizona University, analyzed the burial practices of the Flagstaff area as already known 30 years ago and found some significant patterns. Following the eruption of Sunset Crater, two burial programs were followed, resulting in discrete cemeteries of either cremations or inhumations. Yet the quantities and qualities of grave offerings "mirrored" one another (Hohmann 1983; Plog 1984:277; see also Hudgens 1974). To explain this pattern, Hohmann (1983) suggested that Sinagua society was organized according to dual principles into moieties, each of which sent their dead to the afterworld along different trajectories. In the Elden phase he found age and sex no longer accounted well for the quantities of grave goods, but that there was apparently a qualitatively new principle in play, which he thought had to do with the emergence of ascribed status and hierarchical social organization. Kamp and Whittaker (1999) challenge this conclusion, showing that at smaller nucleated hamlets like Lizard Man presciosities are also found (see also Dixon 1956).

A great controversy arose in Southwestern archaeology in the 1980s between those who favored interpretations like Hohmann's, which were championed by Fred Plog and his students, and those who argued that ceremonial roles and seemingly simpler social arrangements involving sodalities that cross-cut clans or moieties and that they were sufficient to explain the patterns in the data (see Cordell 1984:346-350). The latter perspective was championed by Stephanie Whittlesey (1978) whose dissertation on the fourteenth-century burial assemblage recovered from Grasshopper Pueblo was paradigmatic. Hoping to find some common ground in this controversy, Plog (1989:278) quite reasonably commented on Hohmann's findings, saying that "it seems clear to me that in most analyses one finds a clear distinction between age/sex based distinctions of earlier time periods and those of later time periods when distinctions beyond age and sex occur." What explains such a change he implies was still a matter of opinion at that time. To my knowledge, that is where these fascinating issues still stand (but see Rice 2000).

However, one more pattern of great interest can now be discussed. One of the most striking artifacts found with the Ridge Ruin magician was a turquoise-mosaic raptorial bird emblem; indeed there were three examples (Mc.Gregor 1943). Turquoise-mosaic toad emblems are also present in the Flagstaff area at the same time, and are also found in the Prescott area, the Middle Verde Valley, and the Pollock site on Anderson Mesa at equivalent periods or a little later. During the fourteenth century one or both of these two emblems are found at Chavez Pass and in the Phoenix Basin, Tonto Basin, Gila Bend, southeastern Arizona and all the way to Paquimé in northwestern Chihuahua; about 59 of these emblems from all periods and places are currently known, those in the Flagstaff area being the earliest (Wilcox 2003). Most are with human burials, which often were young children (possibly indicating ascribed status); in only one case are both emblems known from a single context, a cache buried below a floor of a room in Compound A, Casa Grande Ruins National Monument (Huffman 1925).

Recently, Wilcox and others (2008a) have suggested that these symbols are emblems of office in a dual organization that structured the fourteenth century Salt River Valley Hohokam villages into a single polity, similar organizations presumably being emulated in surrounding areas (on the Tonto Basin, see Wilcox, Robertson and Wood 2001b). This is a time largely following the depopulation of the Flagstaff area. Yet it seems that the ideas for this kind of organization arose first in Flagstaff among Sinagua populations that already had, by Hohmann's inference, moieties responsible for death rituals. What now leaps to mind is the fact that in the Phoenix Basin during the Classic period, which began ca. 1100 CE, the earlier burial program of cremation involving a set of distinctive, iconographically charged ritual paraphernalia (palettes, carved stone bowls, carved shell, etc.) abruptly disappeared, and was replaced by a dual system of separate cremation and inhumation cemeteries (Doyel 1981). The cremations during the Classic period were often placed as secondary burials in redware jars. Interestingly, redware (Turkey Hill Red on Angell Brown paste; Sunset Red) had long been a common feature of Flagstaff burial assemblages in the twelfth and thirteenth centuries (Hohmann 1983; Downum 1988). Judy Brunson (1989) in her reanalysis of the burial assemblages from the Classic-period Hohokam Los Muertos site (Cushing 1890; Haury 1945) found that the cremation and inhumation cemeteries, which were distinct from one another, "mirrorred" one another (if you will) in both having comparable amounts of exotic goods. Following Hohmann's (1983) insight, we may suggest that these burial patterns are evidence of moiety organizations. Whether the dual organization indicated by the turquoise-mosaic toads and raptorial birds cross-cut that indicated by different burial programs, or are one and the same, needs to be investigated further.

The Political Importance of Cotton

Cotton seed is edible, but its political importance lies in the evidence 1) that it was somehow grown in certain micro-environments of the Flagstaff region—best demonstrated in the variety of plant parts found in Wupatki Pueblo (Folb 1996); 2) that its fibers were woven into textiles—again, best demonstrated at Wupatki Pueblo (Folb 1996); and, more controversially, 3) that its weavings were exchanged both into and out of the Flagstaff region. The hypothesis of trade into the region was first clearly stated by the great Southwestern analyst of cotton textiles, Kate Peck Kent (1957:468-469), but, following Bartlett (1934:46-47) she thought that growing cotton in the Flagstaff region "might not be feasible." Folb (1996), who knew better, goes to the other extreme, assuming that the entire textile sample from Wupatki Pueblo (37 specimens, whose characteristics she nicely analyzes) were all locally made. However, the presence of so many exotic items at the site, many of which came from amazing distances away (Stanislawski 1963; Wilcox 2002), make it more reasonable to assume that at least the eight fancy weaves were traded in. How such trading may have been organized, and what political implications such trade may have, are now discussed. It is shown that textile production and exchange may have had far-reaching implications for an explanation of the cultural dynamics of Flagstaff prehistory that directly affect considerations of the national significance of its archaeology, including that of the study area. A clay bead whorl was found in a study area site during the present study (Walter Gossart, personal communication 2011).

First, let us look a little more closely at some of the facts now in evidence about cotton production and weaving in the Flagstaff region. Cotton seed was found at Winona or Ridge Ruin (Mc.Gregor 1941:298): '[t]hese demonstrate the presence of cotton and indicate it was cultivated in the area… A small amount of charred lint adheres to some of them." Furthermore, Colton (1946:291) found that of 49 totally perforated sherd whorls then known in the region, they were more common at Cohonina sites, while in Sinagua sites, where only nine discs were known, "three of the 9 [were] made from Cohonina sherds." Loom holes were found in a rectangular pithouse (kiva?) at the Cohonina Juniper Terrace site, probably dating to the middle-to-late 1100s CE (Colton 1946; Wilcox 2002; see Figure 3.9). At the Sinagua sites of Lizard Man (Kamp and Whittaker 1999) and in the Walnut Canyon cliff-dwellings (Downum 2000), cotton is reported (see Appendix 3.1).

Elsewhere (Wilcox 1987b:145-162, 168-173) I have sketched a theory about the importance and structure of cotton exchange in the American Southwest. Based on Kent's (1957) results, I found that textiles from the Colorado Plateau are most often made with a twill technique, while those in the southern Southwest are often made with a weft-wrap openwork technique, a general finding also reported (with greater sophistication) by Teague (1998) and Webster (2007b). The tiny number of twill specimens found in sites of the southern Southwest, or of weft-wrap openwork from Anasazi sites on the Colorado Plateau, led me to question the hypothesis of an integrated long-distance exchange system in favor of one involving more local marriage-exchange networks. A quantitative study of spindle whorls, including clay bead-whorls, sherd whorls, and stone whorls, following the insights and methods of Mary Parsons (1972), showed that the former were probably designed to make fine cotton threads, the latter to make ixtle fiber threads (from yucca or agave fibers), and the sherd whorls were intermediate, but suitable for making cotton threads. Hohokam textiles often had a larger count of warps than wefts (Kent 1957:491, 639; see also King 1965:111), which the bead whorls may have been designed to allow. The distribution of bead whorls is thus a technological indicator of where Hohokam-style textiles were being made (Wilcox 1987b). None are known on the Colorado Plateau, except for a few in the Flagstaff area (Wilcox 1986c), including the Walnut Canyon study area (see above).

After a review of the distribution of evidence for cotton production in the Southwest, which showed that little textile evidence exists anywhere before about 1100 CE, I came to a basic hypothesis: changes in the political economy of Southwestern populations after 1100 CE created a demand that kept increasing for cotton textiles needed for marriage exchanges and for ceremonial costumes (Wilcox 1987b). The Hohokam Sedentary/Classic transition began about 1100 CE, and I now know that a widespread pattern of hilltop sites throughout west-central Arizona (below the Mogollon Rim south and west of Flagstaff) became established then as well, as was a 30 mile buffer zone separating them from the Salt River Hohokam villages (Wilcox, Robertson and Wood 2001b; Wilcox and Holmlund 2007; Wilcox et al. 2008b). Some of these hilltop sites had many spindle whorls (Gumerman and Spoerl 1984), and the fact that some ceramics from the same locality made it into the Phoenix Basin (David Abbott, personal communication) shows that some exchanges transcended the boundary indicated by the buffer zone, though whether marriages were involved is unknown.

The 1100-1130 CE period was also the peak period, or “climax,” of the Chacoan polity in the San Juan Basin of northwestern New Mexico, which was centered on the Chaco Core Community in and around Chaco Canyon (Wilcox 2005b; see Figure 3.7). Though the Chaco polity may have begun to decline after 1130 CE, the presence of many Flagstaff Black-on-white-like designs in the Chaco- McElmo Black-on-white pottery found on the uppermost floors of Chaco Canyon’s great houses (Windes 1985; see Wilcox 1999; Wilcox, Keller and Ortiz 2000) means (by a straightforward application of ceramic cross-dating) that—contrary to many claims in the literature—the Chacoan polity persisted into the late 1100s and perhaps as late as about 1225 CE (see also Vivian and Reiter 1960). Given the quantities of exotic items found there (Judd 1954, 1959; Hargrave 1970; Crown and Hurst 2009), this polity in its heyday was a likely source of demand for exotic items needed to ironically demonstrate the political legitimacy of its leaders (Wilcox 1999, 2005b; Wilcox et al. 2008a). It was in this macroregional context that the cultural “crisis” (see Colton 1942) experienced by this polity in the later 1100s CE, and the ramifying effects that had on its neighbors, brought about the fundamental political and economic changes recognized in the Flagstaff area after 1125 CE discussed above.

There is no denying that a prelude to these changes--uniquely in the Flagstaff region--was the eruption of Sunset Crater and the effects it had on the Flagstaff landscape, forcing a depopulation of a substantial area that became a no-man’s-island between the Sinagua and Cohonina (Downum and Gumerman 1998; Hooten and Ort 2007; see Figure 3.5), and at the same time improving the previously more xeric zones south, east, and north of that island. Previous occupants of the desolated island, numbering perhaps as many as 2000 people (Waring 2007), presumably moved north into the middle Deadmans Wash area, or south, to sites like Winona (Mc.Gregor 1941) and the Walnut Canyon study area. Others conceivably fled to the middle Verde Valley, returning a generation later, bringing with them the ritual practices associated with Hohokam-style ballcourts (Phil Geib, personal communication). Colonization of some localities, however, was delayed for a couple of generations, including--current data suggests--the Walnut Canyon locality, where a small presence of people in post-eruption years seemingly suddenly expanded and became year-long during the Elden phase (Acord 2005). Even more dramatically, in the eastern end of today’s Wupatki monument (Anderson 1990) and south of there on Woodhouse Mesa (Bern Carey, personal communication 2011), a population explosion occurred in the middle 1100s CE (although there are also earlier Kayenta sites on Woodhouse Mesa (see above). As we have seen above, Downum and Sullivan (1990:5-85) correlate this migration with the depopulation of proto-Hopi populations from northern Black Mesa, which was complete by about 1150 CE (Powell et al. 1983). Why the long delay after the eruption of Sunset Crater in what Colton (1946) thought would be an immediate land rush?

Watson Smith (1952) also noticed this delay and wondered if environmental causes explained it (see also Sullivan and Downum 1991). We may suggest quite a different explanation: changes in the political economy of the proto-Hopi, who began to coalesce at the south tips of Black Mesa into what over the next several centuries became large villages of several thousand rooms, brought about an economic functional differentiation in which some populations were encouraged to colonize places as much as 100+ miles away in Flagstaff, the eastern Grand Canyon and Glen Canyon (Fairley 1989:137-138, 2003:95), and Paiute Canyon (Phil Geib, personal communication) where cotton could be grown, woven into textiles, and traded back to the proto-Hopi core areas. The settlement system of the Wupatki polity (Stone and Downum 1999) may, then, have been a "cat's paw" in the emerging Hopi world. The fact that a string of small pueblos along the edge of Antelope Prairie (Downum and Sullivan 1990:5-86, 5-88) links Wupatki Pueblo to Crack-in-Rock Pueblo (above the Little Colorado River), with Wukoki as an eastern flanking control tower, is evidence of a defensive political strategy oriented to the north. Near Moenavi, along Moenkopi Wash, I have been told by Phil Geib (personal communication) there is a butte-top pueblo with the same ceramic assemblage as at Wupatki Pueblo. Just how these settlements were tied to those on or near the Hopi Mesas remains unknown (and a fine topic for future research!). Indeed, a recent field trip along the road to Crack-in-Rock and onto the CO Bar Ranch led by Bern Carey revealed that parallel to the habitation sites along the base of the Doney anticline are a string of 2-story tower sites whose line-of-sight connectivity suggests a highly integrated settlement system with important military and political implications.

By 1260 CE, developments at Hopi had matured to the point that they did indeed send a colony to the unoccupied Winslow area to found the Homol'ovi sites in a place where cotton could be grown "big time" using irrigation (Adams 2002). The founding assemblages at these sites are Hopi pottery (Lyons 2005). Local pottery production led at once to the creation of Winslow Orange Ware (Lyons 2005). Significantly, little or no Winslow Orange Ware is found in Cohonina, Sinagua, or Kayenta sites in the Flagstaff area, though it does occur in sites in the middle Verde Valley dating to the late 1200s CE (Jim Graceffa, personal communication 2011). New tree-ring dates of about 1250 CE from Wupatki Pueblo on specimens discovered in old collections by Tom Windes (Jeffrey Dean, personal communication), and the latest tree-ring date from Walnut Canyon of 1255+ (found in a trash context below a later floor in NA423: see Appendix 3.1), together with the presence of Leupp Black-on-white in these sites (Downum and Sullivan 1990; Acord 2005) show that occupation in both regions lasted into the third quarter of the 1200s CE (or early Turkey Hill phase). At Old Caves and Turkey Hill Pueblo (MNA collections) and some sites at Wupatki, including Wupatki Pueblo (Reed and Brewer 1937), a few ceramics dating to the last quarter of the 1200s or early 1300s CE are found, but these data, at best, support the idea of a small remnant population, or perhaps the visitation of shrines, not significant occupation (see Downum and Sullivan 1990:5-83).

Most explanations for why the Flagstaff area was depopulated, presumably by migration to Hopi, the Homol'ovis, or the Anderson Mesa sites (Colton 1946, 1960; Downum and Sullivan 1990), simply speculate that the cinder mulch blew away and so the people left (but see Sullivan 1994:201). No convincing data are presented to show when this threshold was crossed. Data now available for the founding of the Homol'ovis (Adams 2002; Lyons 2005), however, and the striking correlation of that moment in history ca. 1260 CE and the abrupt depopulation right afterwards of the Flagstaff region, suggests another explanation. Gresham's law, that cheap goods drive out the good, is relevant here. If before 1260 CE, cotton textiles were worth, let's say, $100, and afterwards only $20, due to the greatly increased supply brought about through irrigated production, should we be surprised that all the earlier small-scale producers readapted and moved somewhere else? Depopulation of the eastern Grand Canyon and Paiute Canyon also came about, roughly at this time (though perhaps a bit earlier in the 1200s in the former; Ted Neff, personal communication 2011). The Chinle drainage in northeastern Arizona, which was apparently the first major center of cotton textile production on the Colorado Plateau based on a long earlier tradition of twill weaves (Laurie Webster, personal communication 2011), at sites like Antelope House in Canyon del Muerto (in today's Canyon de Chelly National Monument), hung on for a little longer, but they, too, were gone by about 1300 CE. This restructuring of macroregional exchange systems led to the emergence of what I have elsewhere called the "Hopi macroeconomy" (Wilcox, Gregory and Hill 2007; Wilcox and Holmlund 2007), but that is a story beyond the scope of this chapter. The take-away point here is that the end of the occupation of WACA and the greater Flagstaff area may well have been caused by changes in the political and economic context of large-scale processes of coalescence happening at the Hopi Mesas and the Homol'ovis.

Results of the MNA/NAU Archaeological Field School, 1985-1986, on Campbell Mesa in the Walnut Canyon Study Area

In chapters to follow in this report, new survey data on sites in the study area are presented. It seems appropriate as a prelude to that for me to report briefly on the unpublished results of the MNA/NAU Archaeological Field School conducted in 1985 and 1986 in two ten-week sessions at three sites on Campbell Mesa (on what is now part of the study area). This work was reported to the Coconino National Forest in a series of work plans and interim permit reports, including a draft monograph (Wilcox 1986c), all of which are available to scholars at the Supervisor's Office, Coconino National Forest, and in the Museum of Northern Arizona Library. Permission to excavate sites under an ARPA permit was approved because at the time Campbell Mesa was part of what was called "base-for-exchange" land, which might be traded to an urban developer for other land deemed more important by the U. S. Forest Service and presumably of comparable value. In 1985 we tested two small sites (AR 03-04-02-1235 and 11237; aka NA19048, 19049) and totally excavated AR-03-04-02-1243 (aka NA19055). In 1986 we returned and excavated most of 02-1235 (NA19048). These sites were found to date to the Winona- to Padre-phase times, about 1075-1150 CE, and before discussing our findings, an analysis I conducted on the data from Mc.Gregor's (1941) Winona site is presented (see Wilcox 1986c). This analysis bears on the general conception of culture history in the Flagstaff area and on the social relationships within settlements in the study area and their relationship to those in adjacent areas. It is thus of considerable importance in understanding what is now known about the social processes that occurred in the study area and their relationship to those in adjacent areas. New insights about the Sinagua social network as a whole are also recognized that bear importantly on the question of national significance, the main concern of this report.

As discussed above, Mc.Gregor (1941) and his boss Colton (1932, 1946) at the time the Winona site was selected for excavation in the 1930s were interested in showing that there had been a land rush to the Flagstaff area following the eruption of Sunset Crater. A ballcourt at Winona indicated to them a Hohokam presence, and there also was a locally made red-on-brown pottery with Hohokam-like designs. While Mc.Gregor (1941) in the end argued that his findings supported the land-rush hypothesis, I noticed in reading his report that he differentiated three classes of houses <u>on morphological grounds</u> as Winona, Angell or Padre houses. Furthermore, he presents what amounts to a seriation of the pottery from each set of houses (Mc.Gregor 1941:61) that implies the Winona houses may have been a bit earlier than the Angell houses, and they in turn were earlier than the Padre houses. Intrigued, I prepared a map of the site, keying out the houses Mc.Gregor identified as Winona, Angell, or Padre styles, and plotting the latest tree-ring dates (most of which were not cutting dates) that went with each (Robinson, Harrill and Warren 1975) (see Figure 3.10).

Studying Figure 3.10, we see at once that the houses are distributed in seven clusters, each of which include at least two house groups, and some of those groups, by Mc.Gregor's seriation, are successive in time. Trash mounds are associated with several of the house groups; at least two of the clusters had cremation cemeteries and three contained inhumation burials. I argued that it "appears highly likely that theses clusters [were] the domains of [distinct] residential units that had more or less continuity over generational time" (Wilcox 1986c:23).

> In general, I infer that the Winona settlement consisted of 4-7 residential units [at any one time], each of which buried their own dead. Each residential unit at any one time may have had from 1-4 houses and 1-2 households. Variability of house size is apparent in at least 4 of the clusters; this may be related to processes of growth and decline in households (see Goody 1971; Netting and others 1984; Huntington 1986). As a whole, even if several other house clusters located nearby are included (see McGregor 1941:8), the Winona settlement is no larger than a hamlet or perhaps 50-75 people. Yet they had a ballcourt that McGregor (1941:88) felt was probably built during the Winona focus--and thus it may have continued to be used throughout the life of the settlement.
>
> Analysis of the tree-ring dates and their distribution reveals some interesting results. The total range of the latest dates from each house is 976+ to 1140+ (see Figure [3.10]). The dates from Winona houses range from 1082+ to 1095+; one [house] has a date of 1082+ and two others have dates of 1086, one of which is a construction date (NA2133A [the "Hohokam house] of Fish, Pilles and Fish 1980]). The dates from Angell houses range from 1082+ to 1120+ and most are in the early 1100s. Only 3 Padre houses had dates: 975+, 1076+ and 1140+. If we assume that the earlier dates are derived from the reuse of old construction timbers [or are much eroded], the late date of 1140+ may be the only one that measures a true construction date for these houses (Wilcox 1986c:23).

These dendro-chronological data appear to support Mc.Gregor's (1941:61) seriation. A chronology of a Winona phase, 1075-1100 CE; Angell phase, 1100-1125 CE; and Padre phase, 1125-1150, is thus indicated, which would move the Elden phase to 1150-1225 CE, as Ambler's (1985) ceramic dating for Flagstaff Black-on-white would indicate (see also Fairley and Geib 1989; Downum 1988).

A review of other dates published by Robinson, Harrill and Warren (1975) appear to support this chronological model (and no data contradict it). Furthermore, "[c]lases are also reported of an Angell house superimposed above a Winona one (McGregor 1941:99), and of an Angell house being rebuilt with a Padre-style ventilator (Colton 1946:177) (Wilcox 1986c:24). In the excavations conducted on Campbell Mesa, where a serious effort was made to define occupation surfaces and their sequences, when the ceramic counts were tallied, further support appeared to be present for a Winona to Angell to Padre ceramic sequence (Wilcox 1986c).

An analysis of the spatial relation of the sites on Campbell Mesa suggested that the "neighborhood" that they were part of was centered where Elden Pueblo was built to the northeast or Turkey Hill Pueblo to the northwest; however, an absence of archaeological survey in the area between this part of Campbell Mesa and the Wilson Project area (Bostwick 1985) to the south (at that time) leaves open the question somewhat as to who their nearest neighbors were (Wilcox 1986c:24-35; see Figure 6, Chapter 6.3). Since then, new survey in connection with this report has filled in the picture for that area (see Chapter 5, this report). The clustering of sites around Elden Pueblo and Turkey Hill Pueblo during the Elden phase is shown in Figure 3.11 (Wilcox 1986c:Fig. 4.5): note depopulation of Campbell Mesa indicated by the triangular survey area south-southeast of Elden Pueblo and thus the shrinkage of the overall social network distribution on this landscape. A similar shrinkage is documented in the study area north of WACA elsewhere in this report.

Prior to the Elden phase, the distribution of sites in the Campbell Mesa area and neighboring areas to the north was an “open network” of fairly closely spaced sites dating to Winona-Angell-Padre times without apparent clustering. Ballcourt sites (Figure 3.6) provided an apparent ceremonial focus to these dispersed Sinagua populations of farmsteads and small hamlets, but even the sites at the ballcourts, like the Winona hamlet (Figure 3.10), are not especially large (cf. Plog 1989). Until more sophisticated studies using the methods of geographic information systems (GIS) can be conduced (see later chapters in this report for a beginning), which might show some additional structure in the site distributions for the Winona-Angell-Padre period, at this point it seems that the Sinagua population <u>as a whole was a single undifferentiated social network</u>, the “Sinagua tribe” (Colton 1942), although what kind of political meaning to infer for that network remains unclear, as Colton (1942), too, recognized (but see below).

AR 04-03-02-1235

Site AR 03-04-02-1235 is of special interest to the study area analysis because, on the surface, it appeared to be a sherd-and-lithic scatter that we hypothesized might have 1-3 pithouses (Figure 3.12). Upon excavation (Figures 3.13-3.14), however, it proved to be an ephemeral sequence of occupation surfaces marked at the top of sterile red clay subsoil by an array of postholes that seemed to define the boundaries of one or more brush structures. The ceramic analysis (Table 3.2) indicates a succession of occupation surfaces from Winona-phase times. A similar assemblage was found in our surface study of AR 03-04-02-1237 (Wilcox 1986c). These findings should be a cautionary tale for the interpretation of other sites in the study area and beyond.

AR 03-04-02-1243

Site AR 03-04-02-1243, too, first glance, appeared to be merely a sherd-and-lithic site, but after another visit we began to notice the presence of a large masonry structure (Feature 1) and the rock outline of what proved to be a shallow alcove house (Feature 2; see Figures 3.16

and 3.17; Table 3.3). Feature 1 had double-wide walls with no apparent lateral doorway (Figure 18, but an array of stones on the floor may have marked the location of a roof hatchway (Figure 3.19). There was no obvious hearth, but part of the floor was plastered. If this was a masonry granary analogous to other described by Hargrave (1933:46-48), it was huge, measuring 17.7 square meters, about four times the size of those excavated by Hargrave. Measurements of the amount of wall fall indicates the walls were 2.1 meters above bedrock, or 1.75 meters above the first outdoor occupation surface.

Our ceramic analyses of the floor and fill ceramics from Feature 1 are as follows:
[On the floor were:]

1. 1 Medicine Black-on-red bowl rim;
2. 1 Tusayan Black-on-red bowl rim;
3. 1 Tusayan Black-on-red body sherd;
4. 1 smudged Turkey Hill Red (?) rimsherd with no eversion of the lip;
5. 3 large sherds of a small Tusayan Corrugated jar that fit together (some of these sherds were in the roof fall; the rim diameter is about 12 cm [only about a quarter of pot present);
6. 1 body sherd of a different Tusayan Corrugated jar;
7. 1 smudged Angell Brown body sherd;
8. 1 unsooted, Angell Brown rimsherd with slightly everted rim;
9. 1 unsooted everted-rim Angell Brown rimsherd.

Mostly in the roof fall, but with some sherds on the floor, were 8 large sooted body sherds and 10 smaller ones from a large Angell Brown olla. Also in the roof fall were 1 sooted, everted Angell Brown rimsherd and 2 smudged, slightly everted Angell Brown rimsherds and 3 body sherds.

Feature 2, the alcove house (Figures 3.16, 3.17 and 3.20), did have a pit that may have been a hearth. Grinding stones in the alcove show it was not an entryway but rather a specialized work area outside the traffic pattern in the rest of the house, a finding that comparative studies support (Wilcox 1986c). At that time, given that alcove houses are unique to the greater Flagstaff region, occurring in both Sinagua and Cohonina sites, I marshaled other data to argue against the "ethnic" uniqueness of these archaeological "cultures" (Wilcox 1986c), but once I learned more about Cohonina archaeology in the Mount Sitgreaves area, I changed my mind (see Samples and Wilcox 1992; Samples 1992; Wilcox n. d.).

The total area of Feature 2 is 30 square meters. Calculations of the dirt and pebbles found between occupation surfaces appears to indicate that this feature was produced by a succession of structures that were made of brush held down by the rock foundation and were lightly plastered. The total size of this site, and the density of artifacts recovered from it led us to infer it was occupied year-round. Perhaps, then, the large masonry structure was occupied in the winter months, as a lightly plastered brush alcove house would not have been too pleasant a place to live in the often rigorous Flagstaff winters.

The ceramic analyses of 02-1243 surfaces and layers (Table 3.3) were compared to those from the other two sites we studied and to Mc.Gregor's (1941:61) seriation at the Winona site:

> The contrast between McGregor’s Angell and Winona foci lies in (1) the slight increase of Tusayan Black-on-red, Holbrook Black-

> on-white, Dogoszhi Black-on-white, and Tusayan White Ware; (2) the decline in the frequency of Tusayan Corrugated and Deadman's Fugitive Red; and (3) the sharp increase in Sunset Red. Except for the increase in Sunset Red, identical differences between the early phase at 02-1243 and 02-1235 and 02-1237 are present. Instead of Sunset Red, Turkey Hill Red [on Angell Brown paste] is well represented at 02-1243.
>
> The contrast between McGregor's (1941:61) Padre and Angell foci lies in (1) the slight increase of Holbrook Black-on-white [Holbrook B?], Walnut Black-on-white, and Sunset Red; (2) the presence of Flagstaff Black-on-white, Coconino Red-on-buff, and Citadel Polychrome; and (3) the slight decline of Deadman's [= Black Mesa] Black-on-white and Tusayan Corrugated. Similar trends are present at 02-1243, particularly in the association of Flagstaff Black-on-white and Coconino Red-on-buff in the upper levels and its disappearance higher up, and the "late" Sosi Black-on-white [Peter Pilles, personal communication 1986] associated with Surface 4, are further support for the chronological conclusion that the early phase at 02-1243 correlates with the Angell phase at Winona and the late phase correlates with the Padre phase.
> .... In the later Elden phase (Mc.Gregor 1941:61) Flagstaff Black-on-white became much more frequent than is indicated by the low absolute numbers of [it] at 02-1243 (Wilcox 1986c:103-104).

More on Ceramic Cross-Dating

Finally, two further comments made by Wilcox (1986c:104-105) are of some comparative interest for modeling ceramic cross-dating (cf. Downum 1988), which is a fundamental concern for all of Flagstaff archaeology:

> [First,] [a]t Winona, Mc.Gregor (1941:61) reports that Coconino Red-on-buff is present in both the Winona and the Padre foci, is extremely rare in the Angell focus, and is absent in the Elden focus. Because it is supposed to indicate Hohokam "influence" (Colton and Hargrave 1973), it is not surprising that it is said to be associated with the Winona phase; what is surprising is its strong presence in Padre phase contexts. Yet the findings at 02-1243 seem to confirm the latter association and its occurrence with Flagstaff Black-on-white. If the Winona-Angell-Padre foci are in fact sequential phases, as argued [above], the distribution pattern of Coconino Red-on-Buff at Winona makes little sense. Probably it should be combined with "Winona Red-on-buff" which is supposed to lack slip. In that case the local red-on-buff would be fairly evenly distributed in the Winona, Angell and Padre phases (see McGregor 1941:61).

> The second comment concerns Turkey Hill Red. Data available to Colton showed that it dated to the Elden and Turkey Hill phases (Colton and Hargrave 1937:165; Colton 1946). The paste of this late Turkey Hill Red is [much] finer than the Angell paste on the maroon slipped variety we have [at the Campbell Mesa sites; probably it would be better to call it "Angell Red," but there is as yet no consensus on this]. At 02-1243 its associations indicate this redware was introduced during the Angell phase and occurs also in the Padre phase, 50 years or two generations earlier than inferred by Colton. At Turkey Tanks Pithouses, NA2098, and [at] Winona, however, data consistent with our findings are reported (McGregor 1941; Colton 1946). Two structures and a large trash mound at NA2098 were excavated and were assigned to the Angell and Padre foci. One sherd of Turkey Hill Red was in NA2098A and 67 more were in the associated trash mound. Also in this mound were 37 Sacaton Red-on-buff [Hohokam sherds] and 84 Coconino Red-on-buff sherds (Colton 1946:179-180). At Winona, Turkey Hill Red was also present at NA 2131K, 2131T, 2133C, 2133D, 2134E, 2134T, 2135A, 2135C, 3644A, 3644A1, 3644B, 3644C, 3644J, 3644K, 3644M, and 3644Q3 (Colton 1946:181-202, 222-236). Two of these sites are assigned to the Winona focus, 5 to Angell and 8 to Padre (Wilcox 1986c:104-105).

A Recommendation of a Scientific Basis for Determining the National Significance of Archaeological Sites in the Walnut Canyon Study Area

Since the 1880s when scientific interest in the archaeology of Walnut Canyon began, much has been learned, and interpretations about it and the Flagstaff region have changed, becoming both more detailed and far ranging. Even in 1910 (Shimer and Shimer 1910), however, a basic fact about these interpretations is clear: they depend on the observation of relationships apparent to the alert observer, and the comparison of patterns in those relationships to similar patterns seen elsewhere (see Wilcox 2005a). Studies initiated by the Coltons (1918) soon led to a clearer understanding of who the neighbors of the Walnut Canyon cliff-dwellers were, and how as joint tenants of the Flagstaff landscape they deployed themselves in time and space to adapt to changing environmental and cultural realities. The eruption of Sunset Crater loomed large in the region's story in the 1930s to 1960s, but then a new era in Southwestern archaeology began during which the earlier interpretations were tested and eventually were revised as new relationships were observed.

The difference between descriptions of the archaeological record and its artifact and architectural morphologies and theoretical propositions about past human behavior became better understood. The theoretical ideas of subsistence-settlement systems focused attention on how people may have acted to restructure the Flagstaff landscape by building homes, agricultural facilities like fieldhouses or seasonal farmsteads and field borders, staking more specific claims to the land and backing up individual rights with group action using powerful symbols. As warrants for the new structures of land use that arguably followed the eruption of Sunset Crater locally, and changing temperature and precipitation patterns more generally, the people of the Flagstaff region, including the residents of Walnut Canyon (at least to a certain extent), found ways to import significant quantities of exotic goods, some of which came from over 500 and even 1000 miles away. Facts like these challenge our scientific imaginations to find new explanations for what is now known that have an important logical property: they must be productive of implications that can be tested by making new observations of relationships in the archaeological record to see if new facts support or refute those implications. They also provide us with a reasonable basis for assessing the national significance of the archaeology.

Take, for example, the interesting explanation offered recently by Stone and Downum (1999) about the archaeology of Wupatki National Monument. We have shown above how new facts can be marshaled to challenge part of their theory and to modify it by substituting Kayenta for Sinagua players in it, arguing that that hypothesis better fits the facts now in evidence. But what, then, of the Sinagua, the nearest neighbors of the Cohonina and Kayenta polities south of the no-man's land island of deep cinders produced by Sunset Crater? Were they, also, a "unity, alliance, or polity?" Parallel in time to political developments of the Cohonina and Kayenta, we see that the Sinagua populations, too, began to coalesce into new social forms: many of them moved into evenly spaced large nucleated hamlets and, by the middle 1100s CE, when Wupatki Pueblo entered its glory period as a gateway for long-distance exchange between the Hohokam and Chacoan worlds (Wilcox 2002; Wilcox et al. 2008a). At some point, after the eruption, the Walnut Canyon cliff dwellings were built, establishing a "straggling village" (Colton 1932b) on the south flank of the Sinagua social network. The post-eruption period was a time of intense ideological ferment out of which emerged new political economies whose outlines are best glimpsed archaeologically in the Sinagua (Ridge Ruin) war leader whose political power was cemented by his role as the head of several different sodalities or ceremonial societies (Mc.Gregor 1943). Was he the war leader of only the few men who lived in the Ridge Ruin hamlet, or the war leader of a larger, multi-hamlet sodality involving the whole Sinagua social network?

In light of the Stone and Downum (1999) model, it seems most likely that the Sinagua, too, were organized into a single multi-settlement polity that was thus able to stand up to both its Cohonina and Kayenta neighbors, and to others to the south in the middle Verde Valley who by the middle 1100s CE were themselves beginning to coalesce into nucleated hamlets sited in highly defendable places like Ruin Point and Sacred Mountain (Pilles 1996; Wilcox and Holmlund 2007; Wilcox et al. 2008b). If so, once the cliff dwellings and "forts" were in place--which on current evidence (Accord 2005) apparently was not until after about 1150 CE, during the Elden phase, the Walnut Canyon "village" was positioned to guard its Sinagua compatriots from threats from the south. Maybe Colton (1932, 1946) was right after all about there being forts (cf. Harper 1993). Finding ways to test such interpretations is now on the cutting edge of Flagstaff archaeology and, indeed, on that of the American Southwest and beyond (Adams and Duff 2004; Wilcox, Gregory and Hill 2007).

One implication of these ideas is that the relationship of the Walnut Canyon subsistence-settlement system to its environment may have involved more than a local, autonomous mosaic strategy to make a living by cleverly exploiting a complex pattern of closely spaced microenvironments--though learning more about how they did do that should be an important research priority. In addition, as a player in the putative Sinagua polity, perhaps having special political duties, the Walnut Canyon community may have been founded at a critical moment when its larger social or political role was needed most. Thus its economic well being may have depended on its economic and social relationships to its Sinagua neighbors as much or more than on the unique environmental characteristics of Walnut Canyon--which probably existed for millennia before the time of the Elden phase, when we are most confident that the cliff-dwellings existed. Finding ways to measure those economic and political relationships should also be an important research priority.

In light of this discussion, the conclusion we reach about the scientific basis for evaluating the national significance of archaeological sites located in the Walnut Canyon Study Area can be stated as follows: First, if the sites in the study area (outside of the current boundary of WACA) were deposited as part of the operation of settlement subsistence systems centered at WACA then they are relevant to the understanding of those systems. A key fact, however, that remains to be determined, is whether there were any cliff dwellings occupied prior to the Elden phase? There is also the question about uses that may have been made of the alcoves in WACA before the puebloan period.

What, then, were the boundaries of the palimpsest of subsistence-settlement systems that played themselves out at Walnut Canyon? During the Archaic period, those systems probably were distributed over large landscapes in which the Flagstaff region may have been only a part. For those systems, our question is moot, both because so little is known about them and for practical reasons. For the present purpose, the issue of boundaries can be reduced to those of <u>local</u> subsistence-settlement systems centered on the canyon during the ceramic periods. Even so, before the Elden and Turkey Hill phase climax of occupation, the nature of the social networks that constituted such systems remains largely uncertain. Were there natural breaks between local networks during each phase of occupation, or is the seeming presence of such local networks more a function of what is still unknown about site distributions due to the patchy character of archaeological survey?

So, the ceramic periods prior to the Elden phase may be too difficult today to evaluate to make the boundary issue a practical one. Indeed (see Chapter 5, this report), if there were pre-Elden phase cliff dwellings <u>in Walnut Canyon</u> that were only seasonally occupied, or if some of them were used only for storage--as Acord (2005) suggests--that would imply that the Winona-Angell-Padre period occupation-sites above the rims in WACA and in the study area were part of the "open network" that seemingly characterizes the "Sinagua tribe" as a whole during that time (see above). However, it should be recognized that the habitation and other sites in the study area <u>and WACA</u> during that time are evidence of the process of colonizing the mosaic environment of Walnut Canyon, which climaxed during the Elden and early Turkey Hill phases. The fact is that we still do not know for certain whether or nor some of the cliff dwellings were built at that time for habitation. The test pits in NA 437 (Downum 2000) showed complex stratigraphy, hinting at a more prolonged occupation sequence that might date back before the Elden phase: new work needs to be done to fully evaluate that possibility. The newly discovered cliff dwellings west of Fifth Fort reported below (see Chapter 5) may also be a part of that colonization process, which began to stress association with the five "fort" locations only as the political climate became more tense once the Cohonina and Kayenta "unities, alliances, or polities" formed. It is interesting that the early Turkey Hill phase occupation in Walnut Canyon shrank down to a focus on third and fourth forts in the 1200s CE (see Acord 2005): would an analysis of the choreographic structure of all five "forts" show that third and fourth forts were the most effective defensive arrangements? If so, then a process of increasing instability involving conflict or the threat of conflict probably was one of the principal parameters of settlement location, which the settlement history of WACA and the study area illustrate.

This leaves the Elden and Turkey Hill phases from the middle 1100s to the third quarter of the 1200s CE. During that time interval, as we have seen, the principal Sinagua sites, including the Walnut Canyon "village," were evenly spaced about 5-7 km apart, in effect partitioning the total resource space among them. Lines drawn halfway between each of these focal sites afford a practical way to define local system boundaries. Such lines define what are called "Theissen polygons" (see Chapter 6). They are a rough approximation of what would be defined by doing a "catchment analysis" to define Walnut Canyon's local subsistence-settlement system during the Elden-Turkey Hill phases. Either way, in the end, local system boundaries are what should be considered as a way to decide what territory should be included in what can arguably be proposed as the nationally significant Walnut Canyon subsistence-settlement system.

The Elden- and early Turkey Hill-phase subsistence-settlement systems centered on the cliff dwellings are what appear to be most nationally significant, based on this perspective. The shrinkage of the zone of small sites surrounding Walnut Canyon in the study area to a tighter clustering in WACA near the rims by the Elden phase (Chapter 5) seems to confirm definition of the Elden-phase WACA subsistence-settlement system as presently included within WACA--but that does not include the sites in the study area, nearly all of which are earlier (Ted Neff, personal communication 2011; Chapters 5 and 7). They are, however, part of a subsistence-settlement system that colonized the Walnut Canyon locality and if it could be shown that at least some of the cliff dwellings were inhabited during that period, I would recommend their careful consideration as also nationally significant.

As discussed in the introduction to this chapter, the archaeological resources in the study area and in WACA might also be nationally significant if the sites manifesting the archaeology of the Sinagua archaeological population as a whole are deemed a nationally significant district. A case for this perspective has been made based on two considerations: 1) the national significance of the Sinagua concept presented by Harold Colton and his colleagues as modified by subsequent scientific research (36 CFR Part 65 a [2]) is a seminal contribution to archaeological knowledge; and 2) the unique role the Sinagua population (polity) played in Southwestern archaeology is a key part of the general story of Southwestern archaeology as presently understood (36 CFR Part 65 a [5]). The discussion presented in this chapter has developed a good case in favor of that position. More generally, a sound scientific basis for making judgments about the national significance of the Walnut Canyon study area's archaeology has been defined.

Acknowledgements. Thanks goes to Ted Neff for inviting me to write this chapter for the Walnut Canyon Study Area investigations. Special thanks also go to Bern Carey for reading drafts of the chapter and providing much information about his on going surveys in the Deadmans Wash area. Alan Sullivan provided bibliographic assistance that was most helpful, and both Peter J. Pilles, Jr. and Christian Downum aided with valuable information.

Figure 3.1. Map of the Greater Flagstaff Area Showing the Spatial Relationships of the Cohonina, Sinagua, and Kayenta Branches (Wilcox n. d.).

Figure 3.2. Photograph of Walnut Canyon Cliff Dwellings (Pattee 1897).

Figure 3.3. Map of Flagstaff Area Showing Access Routes to the Walnut Canyon Cliff Dwellings (Pattee 1897).

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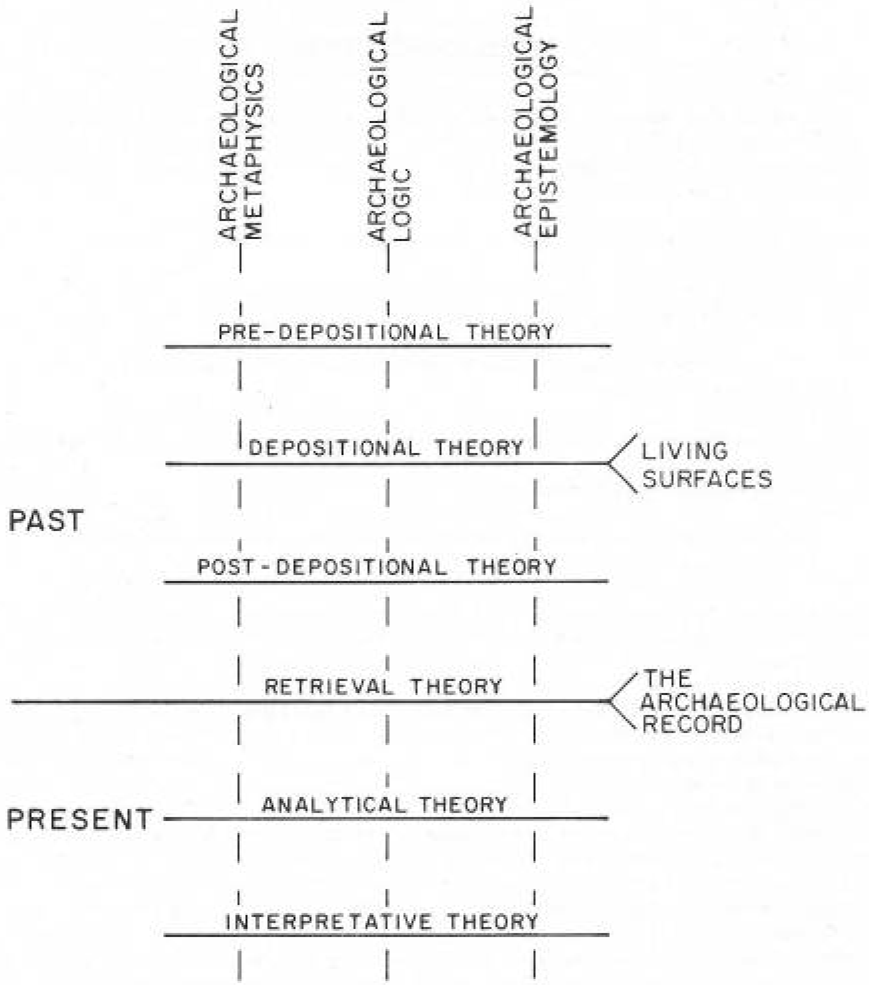

Figure 35. Archaeological theory (modified from Clarke 1973)

Figure 3.4. Model of Archaeological Theory (after Clarke 1973; Wilcox, McGuire and Sternberg 1981:Fig. 35).

Figure 3.5. Isopleth Map of the Depths of Cinder Fall from the Sunset Crater Eruption (after Hooten and Ort 2007) in Relation to Selected Sinagua Sites of All Ages.

Figure 3.6. Ballcourts in the Flagstaff Area (Wilcox 2002:Fig. 3).

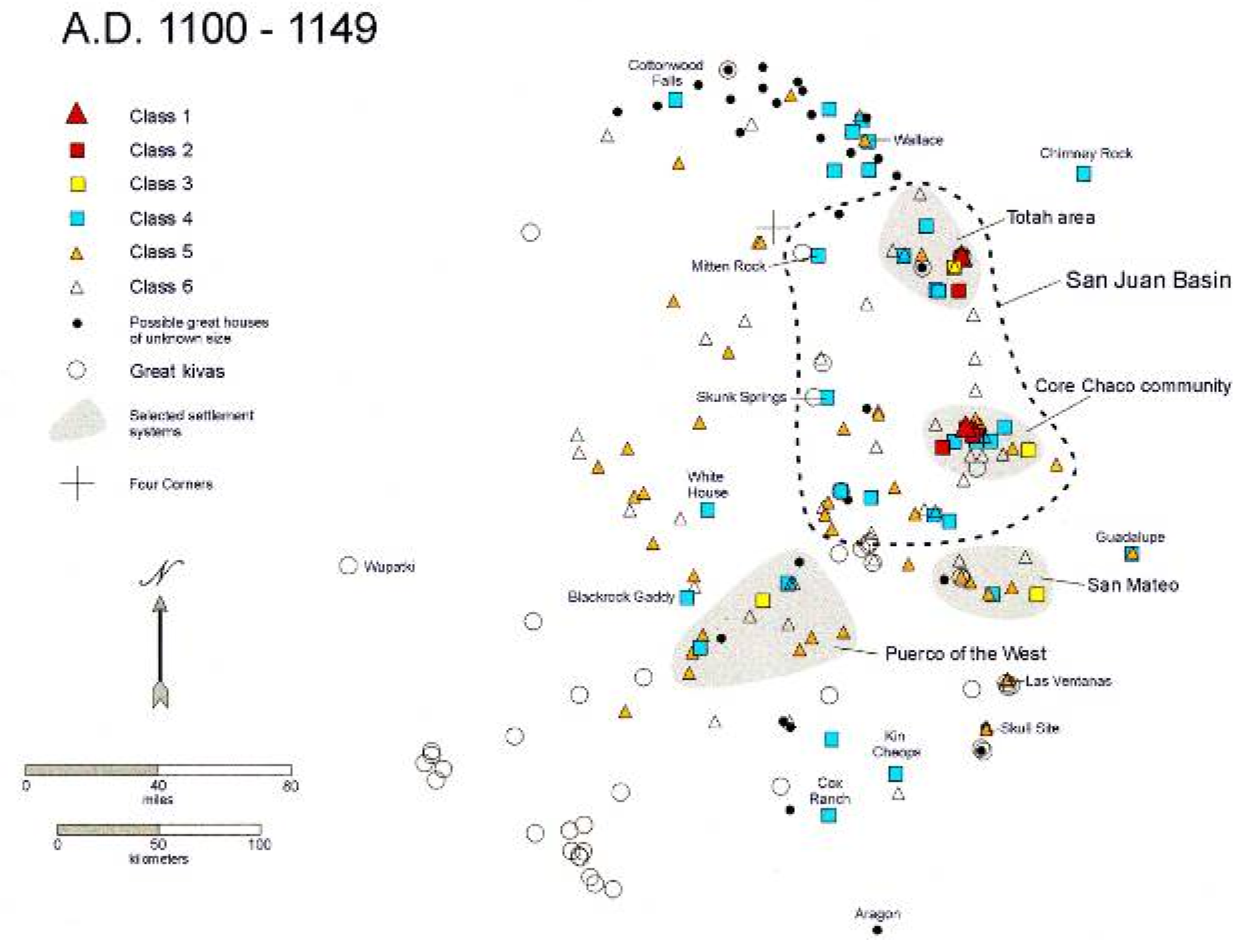

Figure 3.7. The Chacoan World, 1100-1149 CE. Map by David R. Wilcox, Dennis Gilpin, David A. Gregory, and Brett Hill (Wilcox 2005a:51).

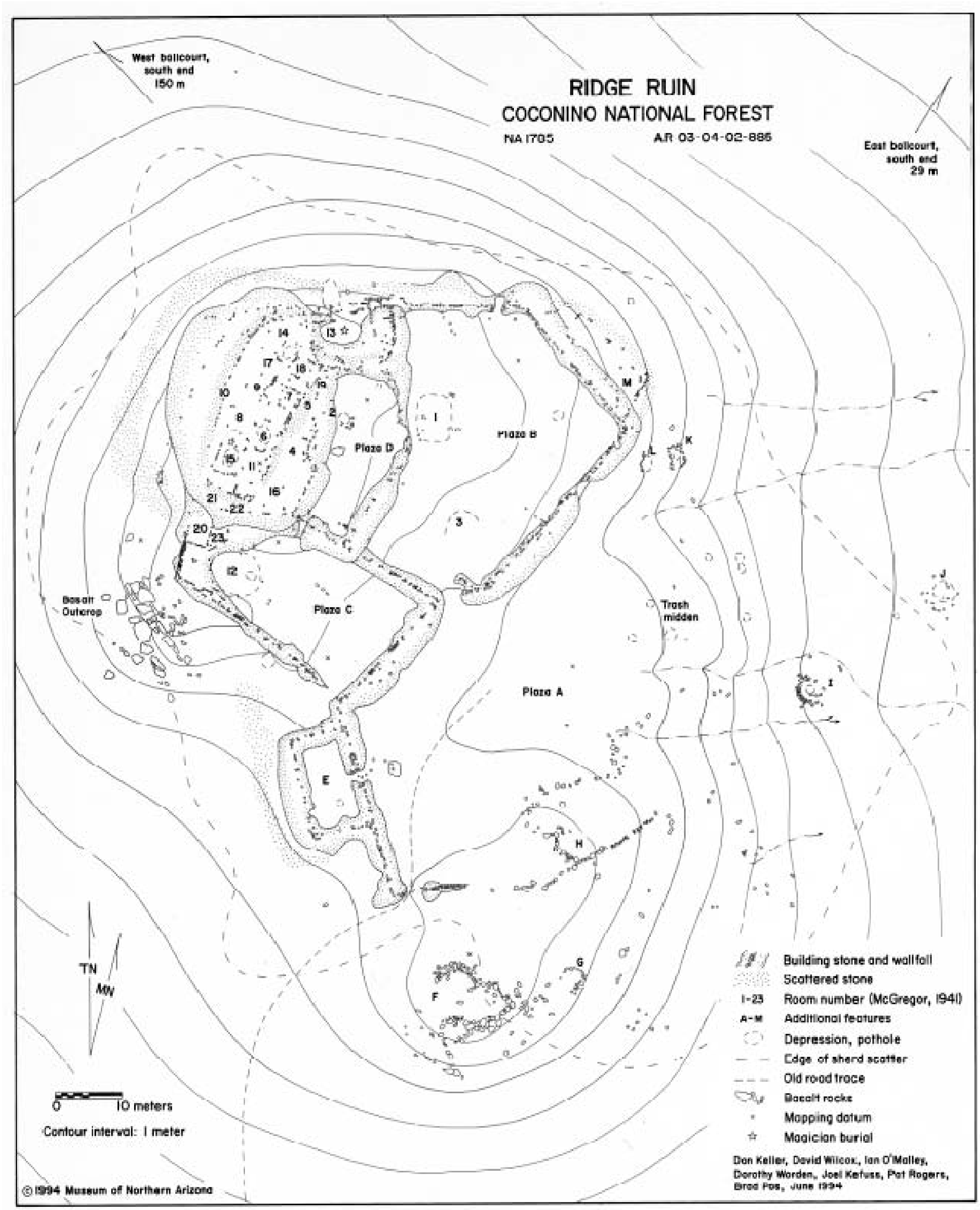

Figure 3.8. The Sinagua Site of Ridge Ruin (NA1785) Showing the Position of the Magician Burial in Its Site Structure. Map by Donald Keller and others (Wilcox 2010:Fig. 71).

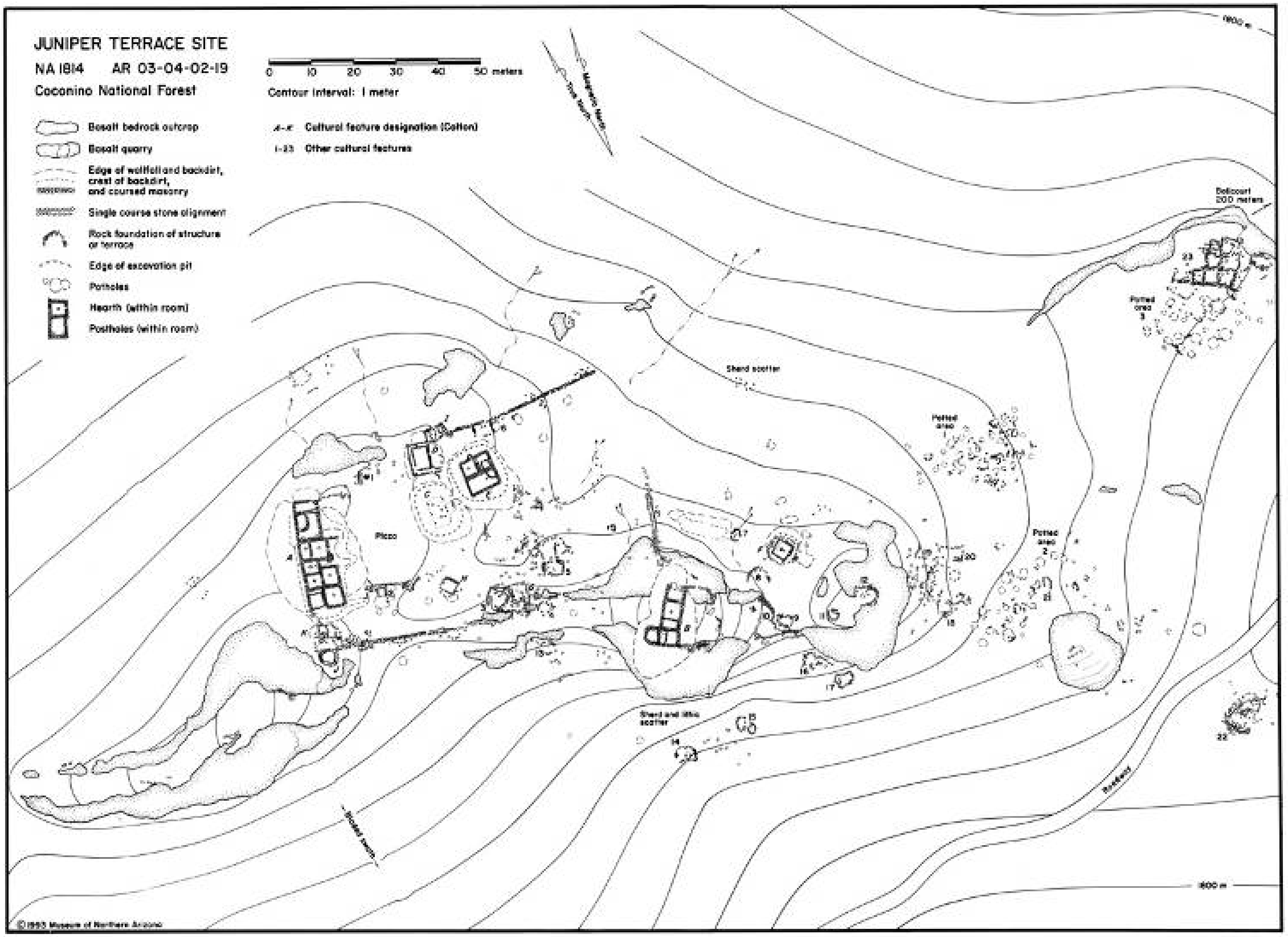

Figure 3.9. The Cohonina Site of Juniper Terrace (NA1814). Map by Donald Keller, Gerald Robertson, Jr., and David R. Wilcox (Wilcox 2002:Fig. 4).

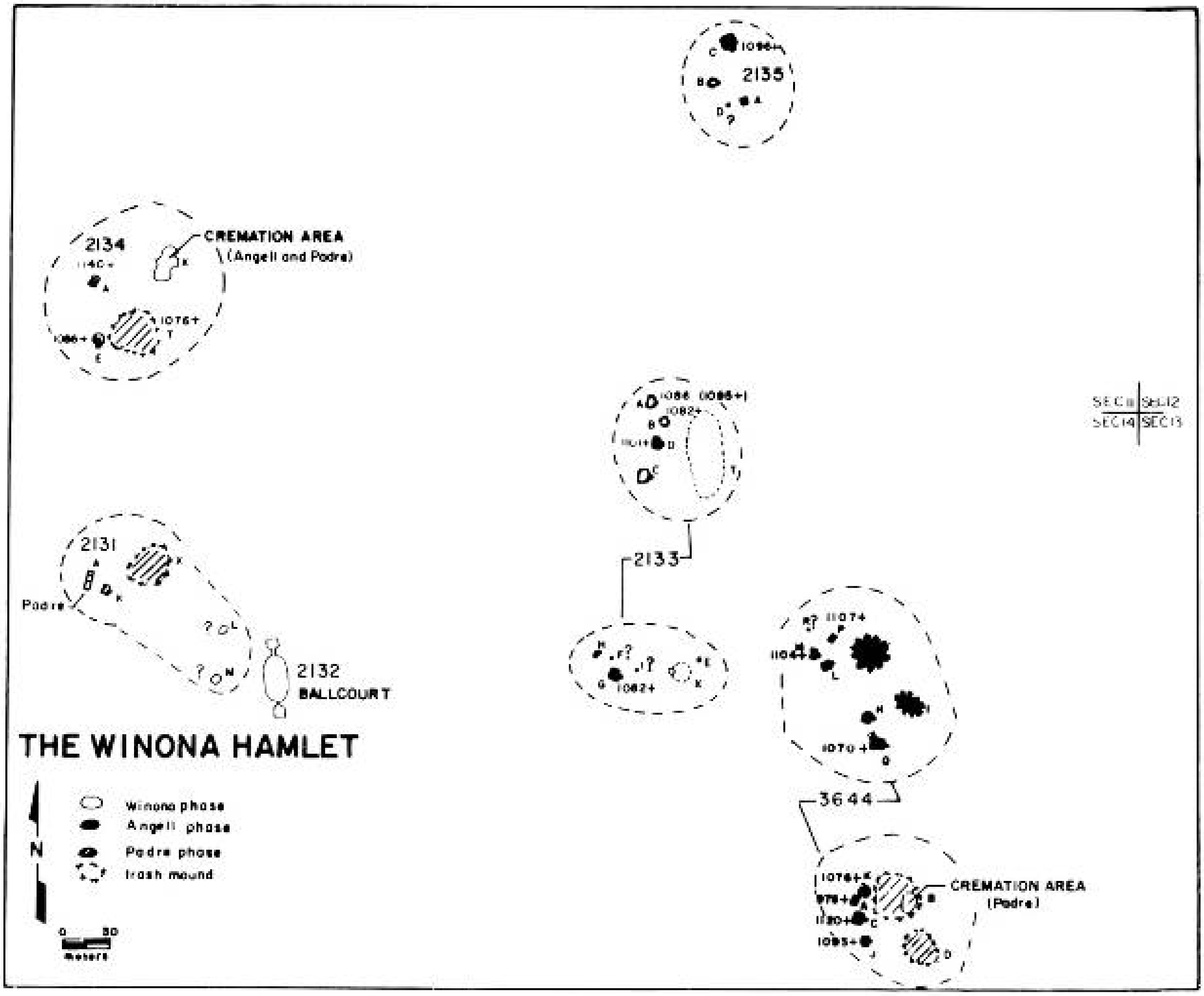

Figure 3.10. The Winona Hamlet Showing the House Styles (Winona, Angell, and Padre) in Relation to their Tree-Ring Dates (Wilcox 1986:Fig.4.1).

Figure 3.11. Site Clusters around Elden Pueblo (Left) and Turkey Hill Pueblo (Right) during the Elden and Turkey Hill Phases (from Wilcox 1986).

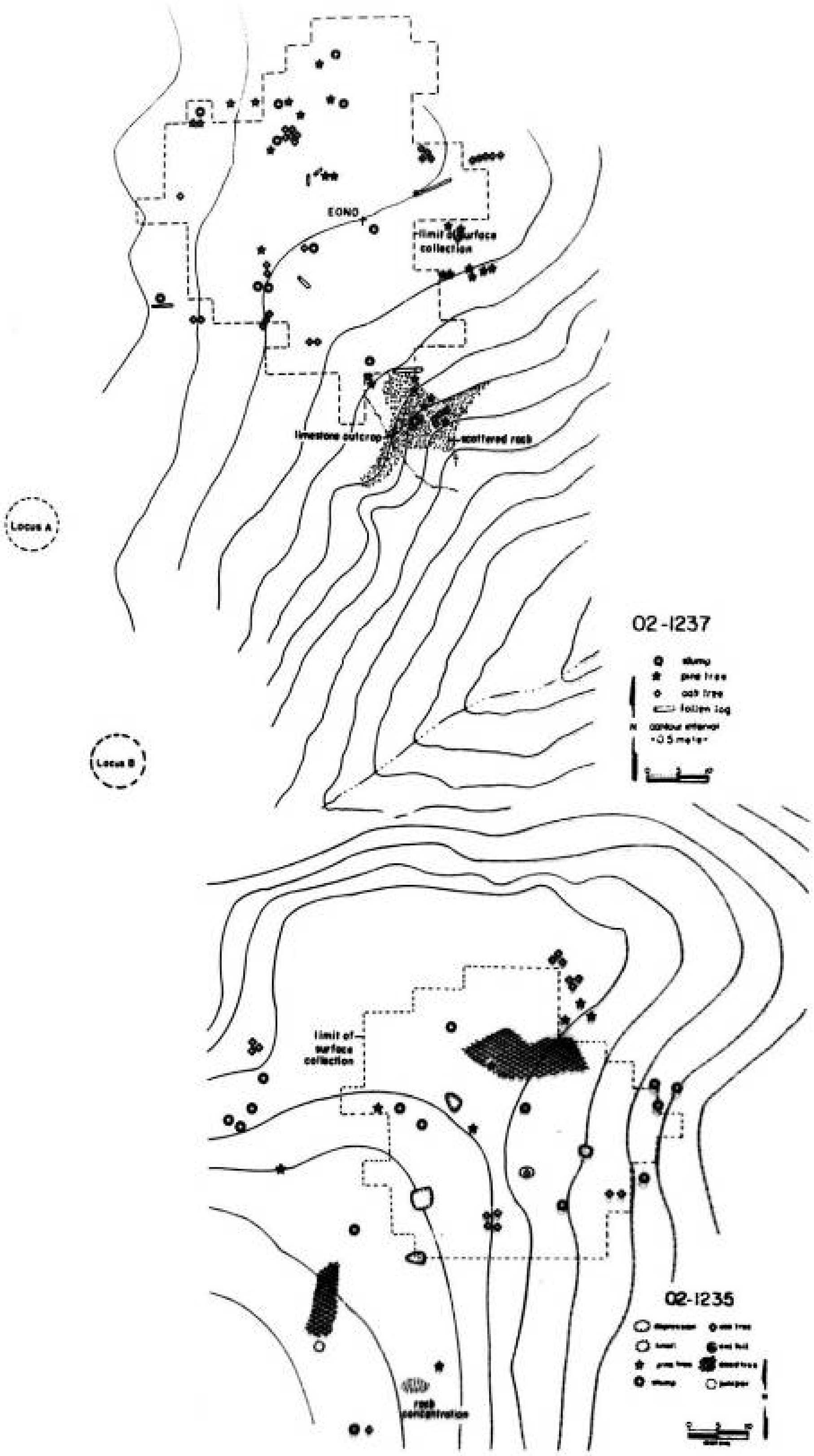

Figure 3.12. Surface Mapping of AR 03-04-02-1235 and 1237 (from Wilcox 1986).


Figure 3.13. AR 03-04-02-1235 Under Excavation, 1986; Left to right: Terry Samples and Douglas Dashiell. Photo by David R. Wilcox.


Figure 14. Surfaces 4 and 5, AR 03-04-02-1235 Exposed in 1986. Photo by David R. Wilcox.

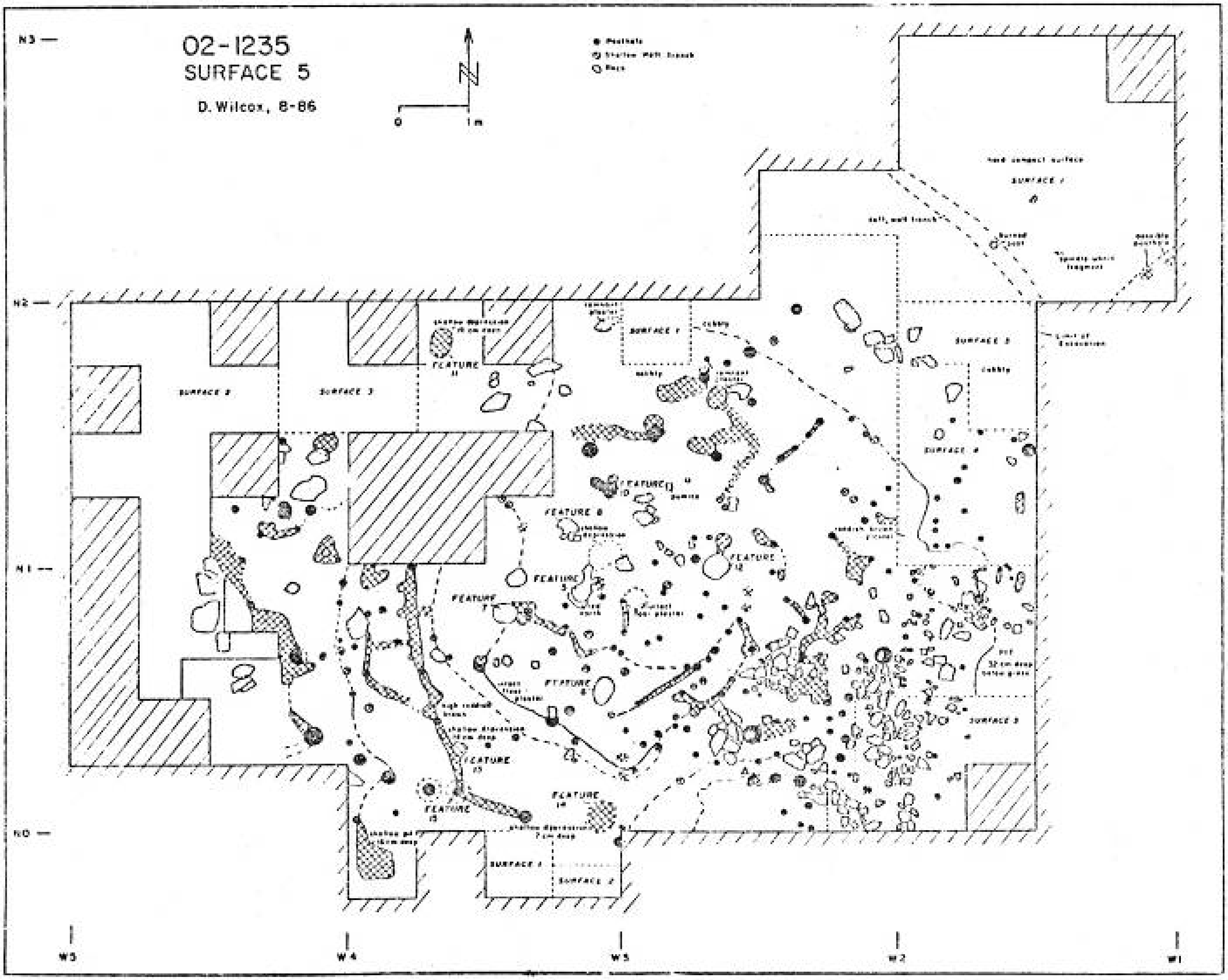

Figure 3.15. Plan Map of Lowest Occupation Surface 5 at AR 03-04-02-1235 after Excavation in 1986 (Wilcox 1987c:Fig. 11).

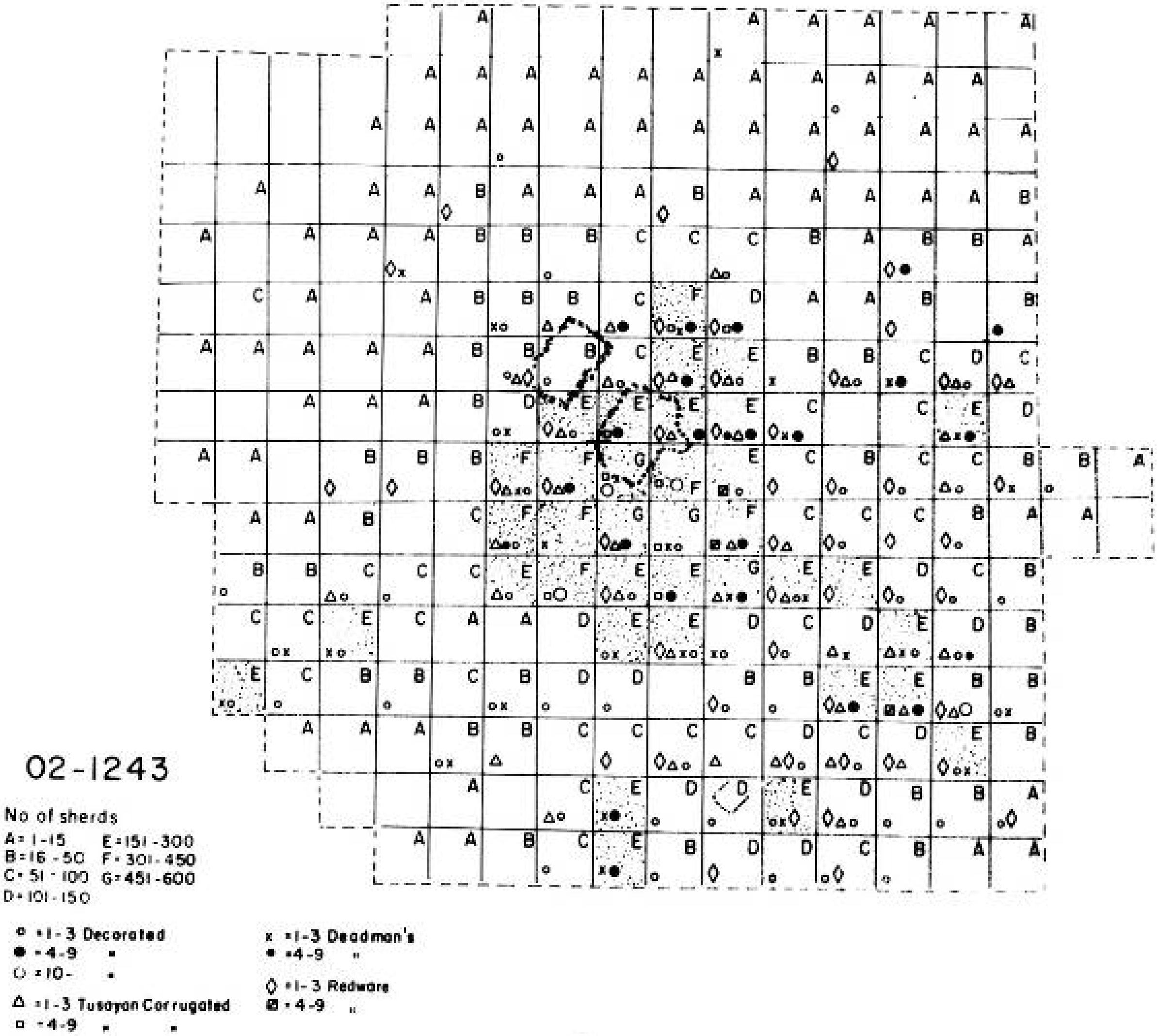

Figure 3.16. Surface Collection Data for AR 03-04-02-1243 (Wilcox 1986).

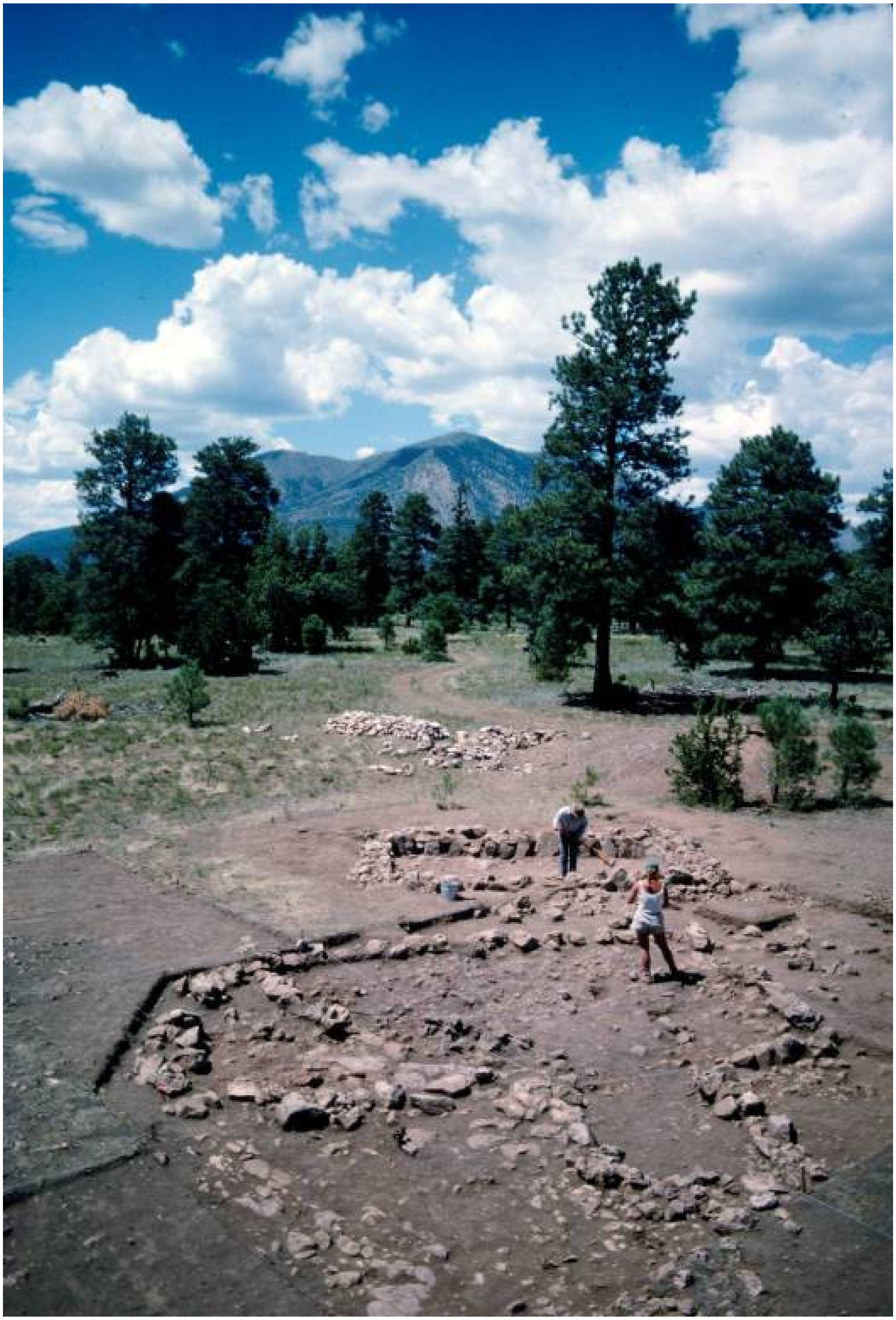

Figure 3.17. AR 03-04-02-1243 After Excavation, 1985. Julie Eddins Stands in Site with Elden Mountain in Background to North Northwest. Photo by David R. Wilcox. Note pile of stones, the wall fall from Feature 1, a large masonry structure.


Figure 3.18. Floor of Feature 1, AR 03-04-02-1243 Exposed in 1986. Photo by David R. Wilcox.

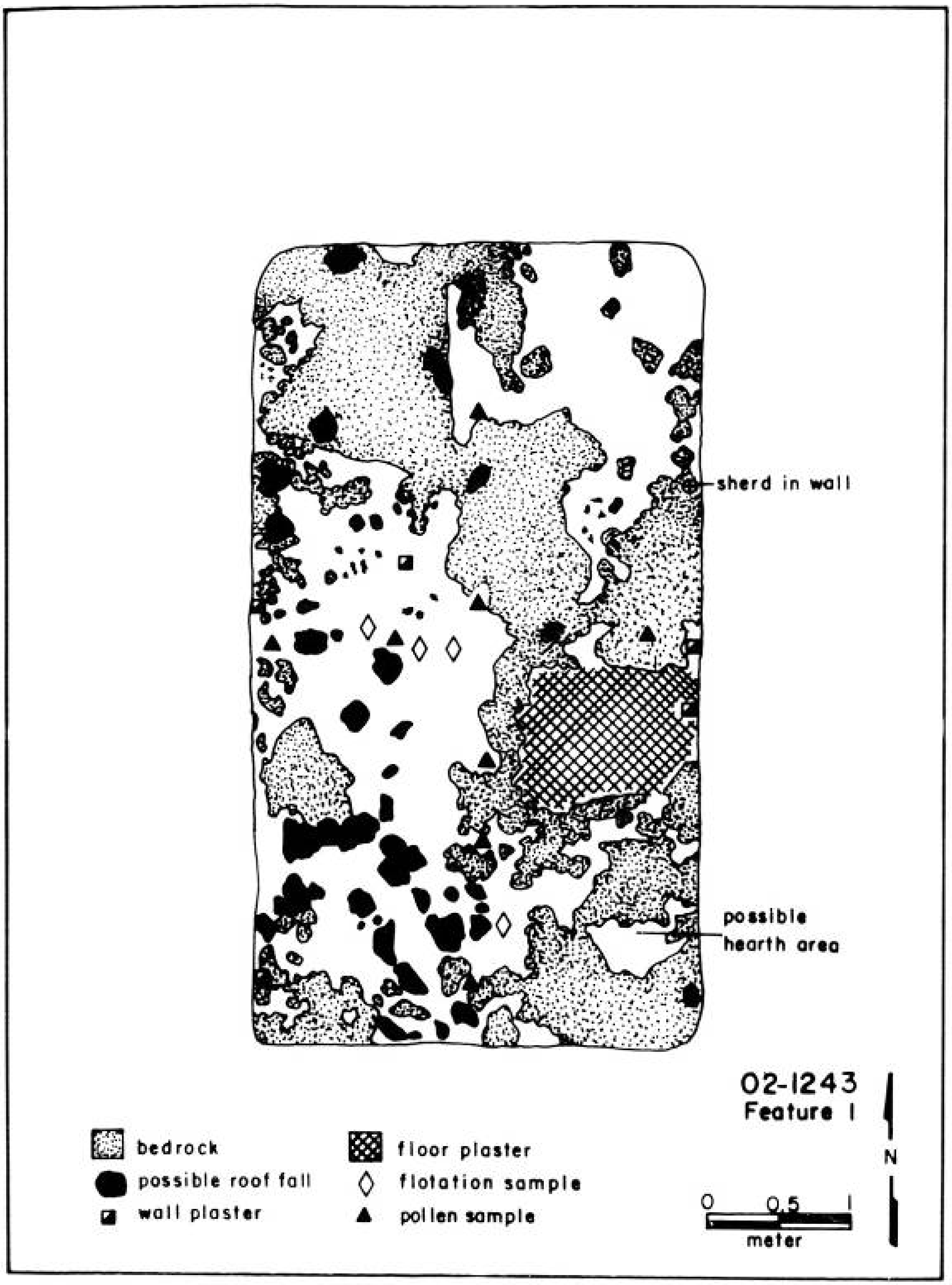

Figure 3.19. Plan Map of Feature 1 Floor, AR 03-04-02-1243 (Wilcox 1986).

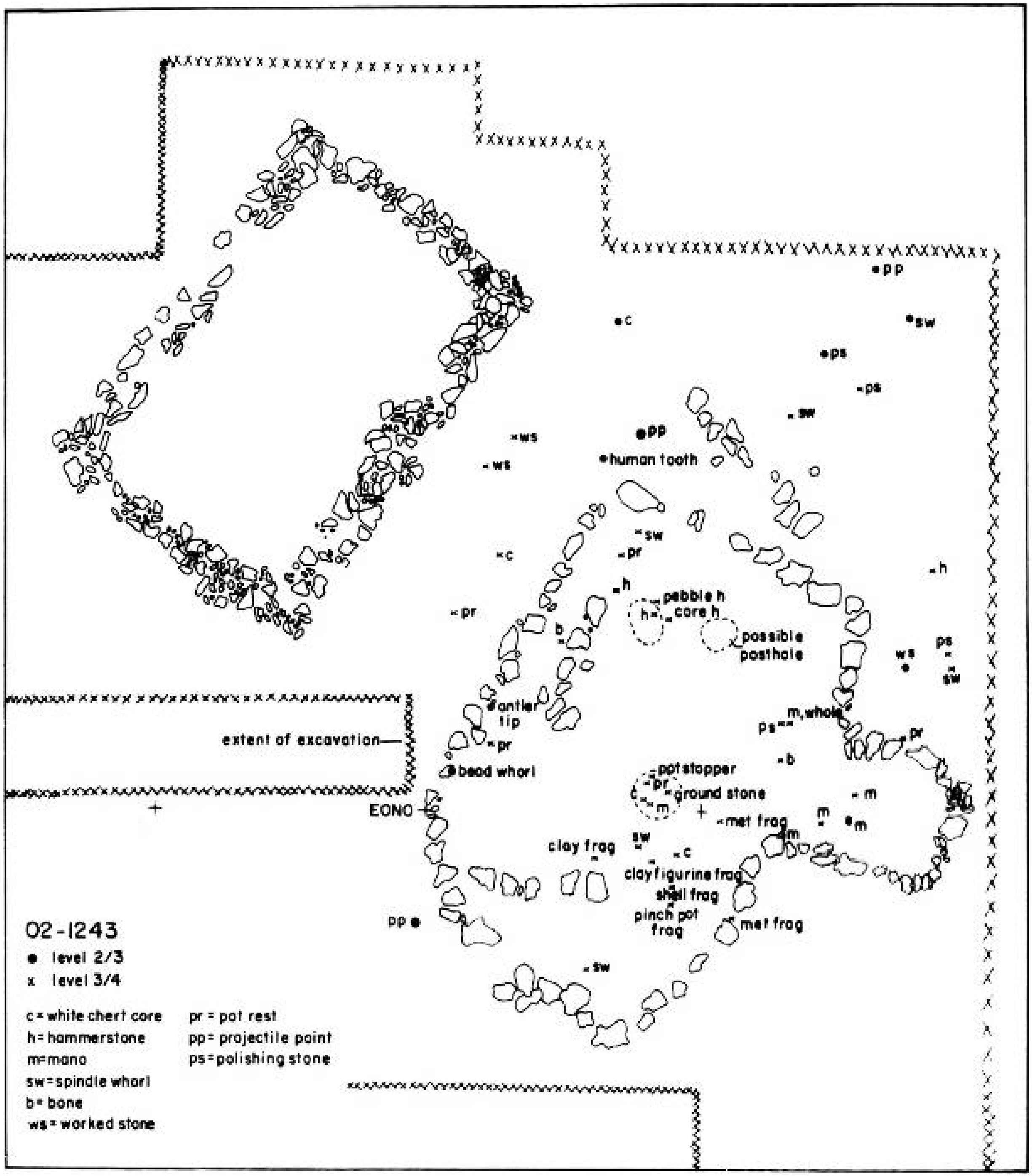

Figure 3.20. Plan Map of Lowest Occupation Surfaces of Features 1 and 2, AR 03-04-02-1243, with North at Top (Wilcox 1986).

Table 3.1. Deadmans Wash Sites Recorded by Bern Carey Compared to Those from Wupatki National Monument.

Comparison to date

Site Type	Wupatki	DMFZ
104-room	1	0
51-room	1	1?
21 to 35 room	8	20+
10 to 20-room	49	50+
Ball court	1	3
Ceremonial room	2	6 (5 Great Klvas)

250+ habitation sites have been identified to date

19 New Large Sites have been recorded in detail to date

A ***standard*** EXCEL-based analysis tool has been developed

Table 3.2. Ceramic Counts from Occupation Layers and Surfaces at AR 03-04-02-1235 (Wilcox 1988).

Table 7.1: Sherd and Lithic Totals from 02-1243.

	TOTAL LITHICS	TOTAL SHERDS	DG	DFR	TC	TW	TsOr	TBR	BM	Sosi	THR	Angell Brown	Coconino R/B	OTHER TYPES
Surface	261	17055	51	8	95	137	19	77	36	9	99	16180	3	1 Floyd? 1 indented corr. 2 PG? 1 cord impr 1 Sunset Brn, 1 THW/R, 8 Rio de Flag? 1 Diablo Br YV 1 San Juan R, 3 Dogz, 1 Flag
Shovel Scrape	128	7603	40	16	59	44	18	14	10	4	43	7419	1	1 Flag, 4 Dogz, 5 Rio de Flag? 1 THW/P 2 unid B/R
Above Surface A	10	587	4	0	7	5	5	0	1	0	2	524	0	0
On Surface #A	7	306	1	0	3	1	2	2	0	1	8	286	0	0
0-10 cm	141	6064	19	10	62	33	16	14	12	4	30	5742	7	6 Flag, 4 Dogz, 4 Rio de Flag? 2 THW/R 1 Med B/R
On Surface #1	62	1654	10	1	25	9	0	5	6	3	15	1569	3	1 Winona Smudged, 2 THW/R, 3 R de F? 3 Dogz, 1 Flag, 1 SF
Between 1 & 2	39	1183	7	4	17	4	1	2	0	3	11	1127	2	1 THW/R, 1 Alma P? 1 Med B/R, 1 Honani T.
On Surface #2	9	328	3	0	5	1	1	3	4	1	3	304	0	1 Flag, 1 THW/R, 1 Med B/R
Between 2 & 3	3	736	4	1	6	2	3	1	3	1	1	713	0	1 Little Col. WW
On Surface #3	17	213	3	2	2	4	2	0	0	0	5	196	0	0
F1: Above Wall Fall	6	253	1	1	2	2	2	0	0	0	0	243	0	2 THW/R
F1: Amid Wall Fall	4	213	0	0	6	0	0	0	0	0	4	202	0	1 Rio de Flag?
F1: Roof Fall	1	122	1	0	7	0	0	1	0	0	0	100	0	0
F1: On Floor	0	48	0	0	8	0	1	1	0	0	0	37	0	1 Med B/R
F2: Between 1 & 2	1	169	3	0	2	1	0	0	0	1	1	161	0	0
F2: On Surface #2	0	30	0	0	0	0	0	0	0	0	0	30	0	0
F2: Between 2 & 3	21	1122	4	4	17	5	1	3	4	1	7	1073	1	1 Flag, 1 Holbrook B
F2: On Surface #3	11	90	0	0	1	1	0	0	1	0	0	86	0	1 Med B/R, 1 Rio de Flag?
F2: Between 3 & 4	23	1082	7	7	8	4	3	4	2	1	6	1039	0	1 Dogz B/W, 1 Winona B/R
F2: On Surface #4	5	197	0	1	4	0	0	2	0	1	2	185	0	2 Med B/R, (1 late Sosi)
F2: Below 4	15	336	1	3	3	0	0	1	0	3	5	319	0	1 Sunset Br? (1 late Sosi)
F3: Above Floor	27	828	5	0	6	3	6	5	1	0	1	797	0	0
F3: On Floor	3	84	0	0	1	0	0	1	0	0	1	81	0	0
F3: Below Floor	2	50	0	0	1	1	0	0	0	0	2	46	0	0
GRAND TOTAL	796	40433	164	58	347	257	80	136	80	33	250	38459	16	1 Diablo Br YV, 1 Honani T. 1 Alma P.T 1 Holbrook B, 2 PG? 1 cord impr, 1 Floyd 1 Sun R, 1 Sun Br, 7 Med B/R, 10 THW/R, 22 Rio de Flag? 11 Flag, 15 Dogz, 1 Winona B/R, 1 Winona S, 2 unid. B/R.

Table 3.3. Ceramic Counts from Occupation Layers and Surfaces at AR 03-04-02-1243 (Wilcox 1986).

	Rio de Flag Brown	Angell Brown	Winona Brown	Sunset Brown	Verde Brown	Unid. Alameda Brown Ware	Black Mesa B/W	Dogoszhi B/W	Shato B/W	Black Mesa-Sosi B/W	Unid. Kayenta B/W	Tusayan Corrugated	Moenkopi Corrugated	Unid. Kayenta Gray Ware	Medicine Blk/Red
Stratum 1 (0-6 cm)	15	1891	0	2	30	0	8	1	7	7	11	50	0	1	0
Surface 1 (6 cm)	4	493	0	0	8	0	8	0	4	0	5	20	0	0	0
Stratum 2 (6-12 cm)	15	1274	1	0	37	1	6	0	1	3	9	42	0	2	1
Surface 2 (12 cm)	4	362	0	0	3	0	5	0	2	1	2	15	0	2	1
Stratum 3 (18 cm)	5	554	1	0	13	0	4	1	2	1	1	23	0	0	0
Surface 3 (18cm)	2	190	0	0	5	0	3	0	0	1	0	8	0	0	0
Stratum 4 (18-22 cm)	0	159	0	0	2	0	1	0	1	0	0	3	0	0	0
Surface 4	0	129	0	0	5	0	0	0	0	0	1	2	0	0	0
Stratum 5	0	42	0	0	1	0	1	0	0	0	1	1	0	0	0
Surface 5	0	21	0	0	0	0	1	0	0	0	1	3	0	0	0
Shovel Scrape	8	1608	0	0	19	0	4	0	5	6	13	41	2	5	0
Features, Levels, etc.	3	267	0	0	7	0	0	0	1	0	2	7	0	6	1
TOTALS	56	6990	2	2	130	1	41	2	23	19	46	215	2	16	3

	Tusayan Blk/Red	Unid. Kayenta Blk/Red	Unid. Tsegi Orangeware	Deadman's Gray	Deadman's Fug. Red	Deadman's Blk/Gray	Kirkland Gray	Floyd Gray	Floyd Blk/Gray	Unid. San Francisco G.W.	Prescott Blk/Gray	Prescott Gray	Little Colo. Corrugated	Unid. L. Colo. White Ware	Unid. Grayware	Totals
Stratum 1 (0-6 cm)	1	2	7	292	43	6	17	3	1	0	1	2	0	0	1	2
Surface 1 (6 cm)	4	0	2	64	38 12	2	4	0	1	0	0	1	0	1	0	637
Stratum 2 (6-12 cm)	1	1	5	193	34	3	16	1	0	0	0	1	3	0	0	1650
Surface 2 (12 cm)	4	1	2	42	14	3	5	0	1	0	0	0	0	0	0	469
Stratum 3 (18 cm)	0	0	0	96	17	2	8	2	0	0	0	0	0	0	0	730
Surface 3 (18cm)	1	0	0	25	13	1	0	1	0	0	0	0	0	0	0	250
Stratum 4 (18-22 cm)	3	0	3	26	3	1	1	0	0	0	0	1	0	0	0	204
Surface 4	0	0	1	18	6	0	1	1	0	0	0	0	0	0	0	164
Stratum 5	0	0	0	5	2	0	1	0	0	0	0	0	0	0	0	54
Surface 5	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	30
Shovel Scrape	0	0	6	197	39	7	14	2	0	6	0	1	0	1	0	1984
Features, Levels, etc.	0	0	0	21	5	9	2	0	0	0	0	0	0	0	0	331
TOTALS	14	4	26	972	188	34	69	10	3	6	1	7	3	2	1	8888

Chapter 4: Historic Previous Research and Culture History

Description and Context for Post – 1850 Sites in the Special Resources Study Area

Historic sites in the vicinity of Walnut Canyon National Monument provide a glimpse of activity in the region surrounding Flagstaff during the late nineteenth and early twentieth centuries. The rich cultural heritage of northern Arizona derives from the presence of multiple ethnic groups. Both archival and archaeological records demonstrate that Arizona's history involves such diverse groups as Native American, Spanish, Mexican, Chinese, Irish, English, German, Basque, and African-American (Cline 1994; Heinlen and Gray 2010; Keane et al. 1992; Mabry et al. 1994; Stein 1991). We know that all of these groups, and probably others, were present in the Flagstaff area and that each produced unique archaeological signatures in some instances. Nearly all of the sites documented in the study area, however, exhibit material remains that are best described as "Euro-American" rather than being diagnostic of a specific cultural group, as is the case elsewhere (eg., Keane et al. 1992; Stein 1991). In the case of the large work camps associated with logging or construction of Santa Fe Dam (see below), the supervisors likely were of Euro-American descent, but photos and historic records demonstrate that a significant number of the workers reflect the diverse ethnicities of the region.

We agree with the salient points often made in juxtaposing the terms prehistoric and historic, and the view that the latter reflects an intellectual attitude emphasizing written documents as an indication of cultural advancement. We specifically reject any implication that Native American cultures occupying the Walnut Canyon region prior to the arrival of various European groups were in some way less significant because they did not exhibit some traits used by anthropological classification systems to distinguish cultures. We further agree that the term "historic" in no way equates with a specific cultural or ethnic group, but rather is a broad temporal period that captures a wide variety of material remains seen at archaeological and historic sites. In this chapter we use the term "historic" to refer to the period since about 1850, marking the initial exploration of the Flagstaff region by American military and civilian expeditions (Cline 1976). Under the umbrella of "historic sites" we recognize locales that likely result from activities of multiple ethnic and cultural groups, although we may not be able to specifically identify each group involved.

Sites with historic temporal components are discussed in this chapter, both those recorded during the supplemental survey completed for the SRS and sites previously recorded on Coconino National Forest (CNF) and WACA lands. These resources can be used to interpret patterns of activity in the study area since the late nineteenth century. The scope of this project does not allow an in-depth discussion of the historical development of Flagstaff; the interested reader should consult Cline (1976, 1994) for a history of settlement and the development of political and economic systems. Of more immediate relevance to the study area, Stein (2006) offers an excellent historic context of the timber industry in the region and a concise history (Stein 1986) of the development of Walnut Canyon National Monument. Additional information on the administrative history of the Monument is provided by Ritchie (1968).

Historic Use and Development of Walnut Canyon

The earliest documentation of ruins in the canyon was by James Stevenson, who led an expedition from the Smithsonian Institution through the area in 1883. The next decade saw visits by numerous scientific researchers, as well as a growing interest in the ruins by local residents. Access to the portion of Walnut Canyon containing the most concentrated prehistoric sites was initially via the canyon from the southwest. In 1884 a trail was established from Flagatff to the north rim, making the trip shorter and offering more direct access to the well-preserved ruins on the canyon's north slopes. Heavy visitation and extensive exploration, including the use of dynamite to remove walls and provide access to the rooms, took a heavy toll on the canyon's cultural resources. By the 1890s, some local residents realized that the ruins offered a tourism opportunity and began to lobby for protection from unauthorized excavation and looting of relics. Besides damage to the ruins and loss of archaeological materials, the natural beauty of the area was marred by visitor trash (Stein 1986:54).

The first protection afforded to the ruins was designation of the area as a Forest Reserve, which was patrolled by a ranger charged with monitoring the ruins and visitor activity. The first ranger assigned to Walnut Canyon, in 1904, was William Henry Pierce, but by most accounts he was largely ineffective at preventing damage to the cultural resources. There is some indication, in fact, that Pierce and his wife were collecting and selling items from the ruins (Stein 1986:60). During the early 1900s local support for protection of the ruins continued to grow as archaeological materials continued to disappear. Although the main concentration of ruins was designated as a National Monument in 1915, it remained under the jurisdiction of the Coconino National Forest until 1934. The Forest Service maintained a ranger at the canyon and made various improvements, but when the monument was finally transferred to the Park Service, funds available for facilities construction and maintenance were quite limited and protection of the ruins was a challenge. The first Park Service ranger, Paul Beaubien, greatly increased visitor contact and education in an effort to protect the ruins and decrease loss of artifacts and integrity of the ruins. Significant improvements came to Walnut Canyon beginning in 1938, when additional lands were appended to the original monument and money was allocated for facilities construction (Stein 1986:66). Manpower provided by the Civilian Conservation Works (CCC) expanded the infrastructure and tourist amenities at the monument, including construction of a visitor center and improvements to the Island Trail around Third Fort. CCC crews also improved Forest Road 303, then part of the Ocean to Ocean Highway, which provided access to the Monument from Flagstaff. Beginning in 1956, a new entrance road beckoned tourists to visit the canyon as the traverse U.S. Route 66 and then Interstate 40 (Stein 1986:68).

The extensive evidence of activity in the forests around Walnut Canyon during the historic period results from its proximity to Flagstaff and the presence of numerous natural resources in addition to the spectacular ruins. Much of the area has been logged and numerous railroad grades were constructed to haul logs to the mills in Flagstaff. Large camps served the logging crews and sawmills were built on the outskirts of Flagstaff (Stein 2006). The north and south rims of the canyon were used as a livestock range until quite recently. Residents of Flagstaff have long used the area for hunting and other recreational activities. Expeditions to the ruins, both scientific and recreational, were particularly popular in the decades around the turn of the last century (Cline 1994; Stein 1986). The presence of a full time ranger at the Monument after 1934 helped decrease vandalism. Most of the dated historic inscriptions recorded in the central monument area were produced prior to 1934 (Stein 1986:Table 2), and the decrease in graffiti is especially significant given increased visitation in later years.

Previously Recorded Historic Sites in the Study Area

Most of the historic sites and components documented within the study area can be assigned to the period between 1897 and 1940, with a smattering of camps dating from the 1950s to the 1980s. The preponderance of sites from the first four decades of the twentieth century accords well with historical accounts of logging and ranching, as well as recreation. Here we present a summary of historic sites documented in the CNF site files; other historic sites are known from the area but information in the files is incomplete.

Logging camps or possible sawmill sites have been documented both north and south of Walnut Canyon. One logging camp or possible sawmill (site number 03-04-02-4221) contains stacked log platforms that could have supported sawmill machinery, rail cars, or other structures. The site was probably occupied by employees of the Greenlaw Lumber Company, a subsidiary of the Arizona Land and Timber Company (Stein 2006:18). Artifacts indicate a date for the site between the 1890s and 1930s, but because logging took place in this area from 1918 to 1923, an earlier historic component may be present but not separable. Another logging camp (05-0059) located in the bottom of Cherry Canyon, south of Walnut Canyon, contains piles of lumber, rock rubble, and a possible sawmill equipment foundation. No artifacts were noted and the age is given only as “historic”. No logging railroads are known to exist along the rugged south rim of Walnut Canyon (Stein 2006) so the camp cannot be associated with a specific logging operation or company.

Two large logging camps were documented on the south edge of Anderson Mesa. One camp (05-0157) contains trash scatters, outhouses, tent foundations, a cellar, a forge, part of a locomotive engine or boiler, and miscellaneous rock, metal, and milled lumber. The other camp (05-0503) contains at least two wooden tent or cabin foundations and five trash scatters. Both of these sites date between 1917 and 1927 based on artifacts, and likely were occupied by crews from the Flagstaff Lumber Company logging areas served by the Anderson Mesa rail line (Stein 2006:36-38, Figure 24). One other logging camp (05-0225) was documented on Anderson Mesa. This site exhibits corrugated tin and milled lumber from a structure, as well as a large pile of lumber that may be the remains of harvested trees that were not shipped to a mill. Although no historic artifacts were reported, the site was assigned a date in the early 1900s and may also relate to logging by the Flagstaff Lumber Company.

Another logging-related site south of Walnut Canyon is the Anderson Mesa Incline (05-505), which was nominated to the National Register of Historic Places in 1994 as part of a Multiple Property Nomination for logging railroads on the Kaibab and Coconino National Forests (Stein 2006). The incline was built in the winter of 1916-1917 by crews from the Flagstaff Lumber Company to provide access to pristine forests on top of Anderson Mesa. Extensive cutting and filling produced a grade 1500 feet long, with a maximum slope of 30 percent. Switching facilities at the top of the grade split the railroad into three lines that gave access to various areas of the mesa, comprising the Anderson Mesa Line. The incline was replaced with switchbacks ascending the mesa in 1918, but logging continued on the mesa for less than a decade.

Several segments of the Clark Valley to Howard Mountain logging railroad (05-592) have also been recorded within the southern portion of the study area. This line was built by the Flagstaff Lumber Manufacturing Company (FLM; later the Flagstaff Lumber Company) beginning in 1909. The company established a large camp on the northeast side of Howard Mountain and logged that area though the late 1910s. Between 1917 and 1926, the FLM extended rail lines farther southeast and south to access Anderson Mesa and the Mormon Lake – Mormon Mountain area (Stein 2006:33-39). Although the overall system of logging railroads on the CNF have been determined eligible for nomination to the NRHP, none of the grade segments within the study area are eligible due to loss of structural elements, later modification, or poor preservation (CNF site files).

Another logging railroad occurs within the study area north of Walnut Canyon (02-4200). The Greenlaw South line was operated by the Greenlaw Logging Company, a division of the Arizona Land and Timber Company. This short-lived line accessed the area northwest and west of the current Walnut Canyon National Monument, bringing logs to a mill at location now occupied by the Flagstaff Mall. The line operated between 1918 and 1923 (Stein 2006:18). Like the Clark Valley-Howard Mountain line, none of the documented segments of the South Greenlaw line retain enough integrity to be considered eligible for nomination to NRHP.

Other historic sites in the study area are associated with ranching or tourism. A homestead or stock camp on Anderson Mesa (05-0504) contains the lower portion of a cabin built of notched logs and milled lumber. A rock ring and two trash scatters are also present. Artifacts suggest occupation in the first four decades of the twentieth century. A historic limestone quarry (02-3872) was documented just south of Forest Road 303, west of the National Monument. The site contains several cement platforms, rubble piles, and two quarry pits. This small quarry may have been used to procure stone for construction of the current Walnut Canyon Visitor’s Center.

Trash scatters unassociated with structures comprise another category of historic sites. One artifact scatter (02-4594) consists of approximately 300 cans (mainly oil cans) and miscellaneous metal fragments. Artifact types indicate a date range of 1946-1954. The scatter is likely associated with construction or maintenance of Hassell Tank, which is directly north. Another historic scatter (05-595) consists of sparse artifacts and steel cable that likely relate to logging activity. A segment of the Clark Valley or Anderson Mesa line runs 200 m north of the site. The former line was used by Arizona Land and Timber Company throughout the 1890s; the latter was built by the Flagstaff Lumber Company in the first decades of the twentieth century (Stein 2006).

Although not within the area investigated for the SRS, sites recorded during survey of the new lands added to Walnut Canyon National Monument (Neff and Spurr 2004: Chapter 5) add information on historic activities and themes relevant to the study area. As with the sites documented on the CNF, these resources overwhelmingly relate to activities such as ranching, logging, and recreation. Other sites include the Santa Fe Dam and associated railroad grade and camp, and an historic telephone line and trail.

Seventeen historic camps were documented in the Walnut Canyon new lands. Several of these contained hearths, rock alignments, milled lumber or other material from temporary structures, and small quantities of trash. Artifacts gave date ranges for most camps, revealing activity from the first decade of the twentieth century through the present. Abundant trash concentrations at three camps reflect large work crews involved in logging or ranching endeavors, as well as construction of the Santa Fe Dam.

Santa Fe Dam (WACA 242) was built in the winter of 1897-1898 by the Santa Fe Railroad to provide water for trails and rail maintenance stations along the main rail line between Winslow and Flagstaff. Archival information about the dam, which is on the National Register of Historic Places, is provided by Baldwin and Bremer (1986) and Rothweiler and Wilson (1979). Associated with the dam is a railroad grade that can be traced as a two-track road from the base of the dam eastward along the canyon bottom beyond the Monument boundary. Also associated are two limestone quarries on the north slope of the canyon, which provided material to build the dam, a road from the quarries to the dam, and equipment platforms. A kitchen area and a trash dump are also present near the dam. The relatively small amount of trash, as well as the lack of evidence for a large camp, suggests the crew of up to 300 men was transported to the dam site each by rail (Neff and Spurr 2004:114-117).

The new lands survey also documented two telephone lines that extended across Walnut Canyon, linking Flagstaff with ranger stations north and south of Anderson Mesa. One phone line (WACA 272) crossed the canyon west of the Monument headquarters, and was associated with a trail (WACA 247) that was mapped by Harold Colton in the early 1920s and referred to as the Telephone Trail (Colton 1932:Plate 3). This line is marked by ceramic ring insulators suspended from large ponderosa pine trees with loops of braided cable. The heavy-gauge, solid-core telephone line can be followed between many of the insulators on the south side of the canyon, but does not currently extend north of the creek. The southern terminus of the line was in Pine, with side lines to ranger stations in Long Valley (Neff and Spurr 2004:101). The phone line at the eastern end of the Monument (WACA 325) was constructed with milled poles, which were cut off when the line was removed. Most poles were removed, although several were left on the steep canyon slopes. Wooden cross beams with insulators were found at 22 poles, showing insulators of a style manufactured between 1924 and 1951. This line did not appear on early forest maps, so the specific termination points are unknown.

Archaeological evidence of Native American use of Walnut Canyon and adjacent lands during the historic period exists but is not extensive. Numerous accounts by early explorers documented use of the canyon region by indigenous groups, mainly in the context of seasonal resource procurement (Stein 1986:69). Pinyon nut harvesting and collection of medicinal plants continues to draw Navajo and Hopi people to the Walnut Canyon area into the present (Stein 1986:69-70). In addition to being a resource area, Walnut Canyon has sacred significance to both the Hopi and Navajo. Survey of the central monument area encountered only one historic Native American artifact, a Jeddito Black-on-yellow sherd (Stein 1986:70) and earlier work documented one sherd of fingernail-incised pottery, probably of Apache origin (VanValkenburgh 1958).

Survey for the Monument new lands expansion documented one campsite with several pieces of Apache Plain pottery, a few prehistoric sites containing one or two sherds of Jeddito Yellow Ware and Hopi Yellow Utility Ware, and two Desert Side Notched projectile points (Neff and Spurr 2004).

Supplemental survey completed for the SRS study documented one pictograph panel in a shallow alcove on the north slope of Walnut Canyon. The pictographs consist of four anthropomorphic figures, one “thunderbird”, and four indistinct elements, executed in dark red/brown and yellow/brown pigment. A few elements are partially outlined in charcoal. Element design suggests the site relates to Yavapai or Apache use of the area. Similar pictographs occur at a small alcove site previously documented near Fisher Point (02-141).

Chapter 5: New Archaeological Survey Research Results

New Archaeological Survey Areas and Methodology

While legacy data will be a primary source for the national significance assessment of the study area cultural resources, newly collected data are also necessary. Thus, two additional survey efforts were carried out by MNA.

First, a preliminary assessment of CNF legacy data indicated that the south-facing cliffs of Walnut Canyon from the west boundary of WACA to Fisher Point had not been surveyed. Additionally, MNA site file records indicate the presence of archaeological sites in this area that were the focus of previous investigations, including the Kaibab limestone overhang where split twig figurines were recovered (Euler and Olson 1965; Olson 1966) and a cave were prayer sticks were recovered (Schley 1964). Examination of the distribution of Sinagua culture cliff dwellings in WACA indicated that the majority of the cliff dwellings are located on south-facing canyon exposures. Given this, it seemed reasonable to expect the presence of additional cliff dwellings on south facing cliff exposures to the west of WACA. Therefore, MNA archaeologists conducted survey of un-surveyed north side (slopes with southern exposure) canyon areas and recorded new archaeological sites that were encountered and also visited previously recorded sites and re-plotted them (see Figure 2.1; survey Area W; survey Area W equals 173.85 acres).

Second, two 160 acre blocks (Areas X and Y) and one 240 acre block (Area Z) were surveyed in areas of high site density north of the WACA boundary within the study area (see Figure 2.1). The purpose of the block surveys were twofold; first to better characterize the kinds of archaeological sites and their temporal affiliations present in this high-site density area and; second, to bound the high-site density area on the east and west.

The crews for the new survey were led by MNA personnel and were composed of a unique mix of archaeologists from MNA, NPS, and very experienced and qualified volunteers from the Arizona Archaeological Society. MNA currently holds the prerequisite permits from Coconino National Forest to engage in this survey. This crew composition reflects the spirit of inter-agency cooperation and public involvement/input regarding the WACA SRS. Specifically, NPS made available one archaeologist with a vehicle and volunteers were from the Verde Valley Chapter of the Arizona Archaeological Society, who have a long history of, and are exceptionally well qualified to, work on the Coconino National Forest.

Archaeological survey methodology for the canyon survey consisted of archaeologists walking along the broader and safely navigable Kaibab limestone ledges that form portions of the canyon walls. Prehistoric archaeological sites are located in these broader ledge contexts and associated overhangs. Canyon survey consisted of a crew of archaeologists, each on a broader ledge, contouring along the canyon face in one direction. The archaeologists maintained a staggered formation to ensure that rocks accidently dislodged by surveyors on higher ledges did not hit surveyors below. For the block surveys, crews surveyed the blocks utilizing survey transect spacing of 15 meters or less. All previously unrecorded archaeological sites found during survey were recorded as per standards established by the CNF for organizations that hold survey permits. This included the filling out of the CNF INFRA site form, preparing a sketch map, doing infield analysis of ceramic, lithic, and historic artifacts, taking of photographs, and recording the location of the site's boundary and datum with recreational grade GPS units. No collections were made. If appropriate, interesting artifacts were drawn and photographed in the field. At previously recorded sites encountered during survey, new photographs were taken, site forms and site maps were updated if necessary, and the location and spatial configuration of the site boundary and datum were checked and updated if necessary.

Description of Prehistoric Cultural Resources from New Archaeological Survey in the Study Area

Table 5.1 summarizes the archaeological site components recorded or re-recorded by MNA in survey Areas W, X, Y, and Z. The table also summarizes the National Register of Historic Places eligibility for each site component. In total, MNA recorded or re-recorded 68 sites consisting of 72 components. Appendix A contains the CNF INFRA sites forms and electronic versions of the site maps for all recorded sites. Figure 5.1 depicts newly discovered and recorded archaeological sites in Area W. Figure 5.2 depicts Area W archaeological sites including previously recorded sites. Figure 5.3 depicts newly discovered and recorded archaeological sites in Areas X, Y, and Z. Figure 5.4 presents the various prehistoric ceramic period chronologies that have been articulated by previous researchers for the Flagstaff area.

Area W

Prior to conducting the survey, CNF and MNA records indicated that six sites had previously been recorded in this area. Notably, two of the sites had been the focus of previous scientific investigation. The Paho Cave site (CNF #02-0549; NA7823 was investigated by MNA archaeologists in the early 1960s and 16 prayer sticks (pahos) were documented in a small chamber at the rear of the cave (Schley 1964). An alcove site (CNF#02-0519; NA5607) was also investigated by MNA archaeologists in the early 1960s. MNA's work at the site found three complete split-twig figurines on the surface and five additional figurines subsurface, as well as 23 figurine fragments from both surface and subsurface contexts (Olson 1966).

Our survey work indicated that the two previously investigated sites mentioned above were miss-plotted on CNF and MNA records. The correct location of these sites is shown on Figure 5.2. Regarding the four other previously documented sites, an alcove site with pictographs and a bedrock grinding slick (CNF#05-141; NA19035) was relocated, re-photographed, and found to be plotted accurately on MNA and CNF maps. The other three previously recorded sites, CNF#02-0666, NA9851 (an alcove with a few ceramic artifacts), CNF#02-0667, NA9852 (an alcove with a masonry wall and some ceramic artifacts), and CNF#02-0773, NA9853 (an alcove with a few ceramic artifacts) could not be relocated in their plotted positions nor did any of the other sites documented during the survey match the descriptions or photographs of these sites. Thus, Figures 5.1 and 5.2 do not depict these sites.

Twelve previously unrecorded sites were located and documented (see Table 5.1; CNF#02-5325 through 02-5336). Table 5.2 further summarizes the sites in Area W. Taken together, the 15 sites represent 18 masonry rooms under alcoves, pictographs, a ceremonial cave, and an alcove that contained Archaic period deposits. Appendix B presents 23 photographs to give the reader an idea of the character of Area W archaeological sites. The sites are in good condition and show no recent or obvious signs of damage. The CNF has closed many of the two-track roads that once provided motorized vehicle access to rim areas above the sites. For the most part these closures are being observed by the public. The non-motorized vehicle Arizona Trail runs near the north rim of the canyon in this area. Use of this trail does not appear to be impacting the documented sites in any adverse way.

Area X, Y, and Z

Survey Areas X, Y, and Z constitute 560 acres or three and a half 160-acre quarter sections. We documented 58 archaeological sites across the three areas. As expected, the site density was quite high at approximately 16 sites per quarter section. Prehistoric sites with Sinagua cultural affiliation dominated the documented site assemblage, although sites with Euro-American cultural affiliation were also observed (see below). Also, as expected, none of the prehistoric Sinagua sites encountered were architecturally imposing. We documented two sites with three to four room units that did not exhibit full-height masonry and two sites with two-room architectural units that did exhibit full-height masonry. Most of the prehistoric Sinagua sites consisted of discrete artifact scatters, dominated by ceramics that were at times associated with masonry structures that rarely exhibited more than one room. Our preliminary interpretation of the vast majority of these sites is that they are the remains of seasonal farming activity. Only the two sites exhibiting three to four room masonry structures may possibly represent permanent habitation loci.

Importantly, toward an effort to gain better inferences of temporal affiliation for archaeological sites in Areas X, Y, and Z, and thus generally for the high site density area to the north and east of WACA in the study area, we engaged in mean ceramic dating (MCD). MCD is a dating technique where ceramic assemblages are dated based on the average age of recovered ceramics. The technique was first developed and applied to historic ceramic assemblages but has proven useful for prehistoric ceramic assemblages particularly in the North American Southwest where tree-ring dating has resulted in relatively well dated prehistoric ceramic types (see Christenson 1994). Also, Acord (2005) has conducted MCD of ceramic assemblages from WACA and this would afford us a systematic and repeatable dating method for comparison of WACA sites to study area sites.

Of the 42 sites MNA recorded in Areas X, Y, and Z that had ceramics, 28 could be dated using the MCD method. Table 5.3 presents the mean ceramic dates for these 28 sites. As mentioned above, Acord (2005) engaged in MCD for sites in WACA. Figure 5.5 presents a comparison of MNA sites and WACA sites (Acord 2005) dated by MCD. The bar chart depicts the frequency of dated sites within nine 25-year intervals stretching from pre A.D. 1050 to post A.D. 1225. The bar chart indicates that 21 of the 28 were occupied prior to A.D. 1150 while the vast majority of the WACA sites were occupied after A.D. 1150. This strongly suggests that the MNA study area sites and the sites within WACA are not associated with each other temporally. This inference becomes important in the consideration of the national significance of cultural resource properties in the study area outside of WACA (see Chapter 7).

In general, the sites documented in Areas X, Y, and Z are in good condition and show little evidence of disturbance other than the non-specific impacts of natural erosion processes. The Coconino National Forest has closed many of the two-track roads in the surveyed areas and the public is observing for the most part these closures. Additionally, the surveyed areas are free of recent trash.

Description of Historic Cultural Resources from New Archaeological Survey in the Study Area

Eight sites with historic components were documented during new MNA archaeological survey in Areas X, Y, and Z. Only one of the sites also had a prehistoric component; Table 5.4 summarizes the historic features and artifacts documented at each site.

Dating Methods and Artifact Types

Establishing a date for historic sites is a satisfying task for many archaeologists because the period of use can often be narrowed to a few years or decades. In contrast, prehistoric sites recorded during survey often must be placed in temporal brackets of hundreds or even thousands of years. As with prehistoric sites, dating of historic resources must be directed toward the episode of activity rather than individual artifacts. Disregarding possible reuse of artifacts such as glass bottles can result in a temporal assignment that is substantially earlier than the actual use of the site (Busch 2000). Whenever possible, temporal assignment should be based on multiple independent dates garnered from the artifact assemblage or features. Most sites in the SRS survey areas offered a diverse artifact assemblage for dating, and the evidence indicated a relatively tight age range for the sites.

Artifact assemblages at most camps consisted of milk cans, beer or soda cans, food cans, tobacco cans, jars and bottles that held food or patent medicine. Milk can measurements, following Simonis (1997), formed a core dating method. Numerous sites contained steel or bi-metal beer cans, the former type manufactured between 1935 and the early 1950s and the latter type beginning in the early 1960s (Maxwell 2000). Bi-metal and aluminum beer and soda cans dating to the last 40 years were also found, often associated with recent hearths; these were typically recorded as IOs. Food cans generally proved too general in size and shape to be useful for accurate dating, although patent or manufacturer’s markings on cans were occasionally used to corroborate dates obtained from other artifacts. Food cans from nearly all sites in the project area were sanitary style, which came into widespread use shortly after the turn of the twentieth century (Busch 1981; Rock 2000). Meat cans with score-strip openings were noted on several sites, indicating a date after 1895 (Rock 2000). A few tobacco cans were found, all of a style manufactured after 1908.

Manufacturing technology and maker’s marks on bottles proved useful for confirming the age of glass artifacts (Firebaugh 1983; Miller and Sullivan 2000; Toulouse 1971). Glass color is seldom diagnostic for dating purposes, with the exception of purple glass. Glass containing manganese to remove color was manufactured during the late nineteenth and early twentieth centuries; when exposed to ultraviolet light, this glass turns gray to purple depending on manganese content and duration of exposure and from this alteration comes the term "sun-colored amethyst" (SCA) glass. After 1917, when World War I disrupted importation of manganese from eastern Europe, selenium and then arsenic were substituted. The presence of SCA bottle glass is therefore useful to identify sites likely in use during early part of the twentieth century.

Historic Site Descriptions

03-04-02-4200

This is a previously-documented segment of the Greenlaw South railroad grade, which was operated by the Greenlaw Logging Company, a subsidiary of the Arizona Lumber and Timber Company. This line was in use between 1918 and 1923, extending to the rim of Walnut Canyon (Stein 2006:18). This grade segment was initially ground-proofed during the Campbell Mesa Road Obliteration project (Crossley 2001) and was also well documented by Gifford (2004). The present survey documented additional detail about the grade segment that crosses the northeastern portion of Section 21. The newly-identified feature consists of a partially intact drainage crossing with constructed rock ballast 'causeways' that support the grade on each side of the drainage. The northwest approach is longer but lower, with a maximum height of rock ballast of approximately 3 feet. The southeast approach involved a low (ca. 2 ft) cut through a bedrock outcrop, with the removed rock used to build a low retaining wall to stabilize the rock ballast for the grade. Eroded logs in the drainage once helped support the ballast on the east side, which is now eroding through natural alluvial processes. The rock ballast exhibits a maximum height of about 4 feet. No ties currently span the drainage between the built causeways. This section of the railroad grade is easily identifiable for at least 300 m and has good line-of-sight through the forest. Where it crosses relatively flat terrain, the rail bed was laid directly on the ground or was built up with 1-2 feet of limestone ballast before the ties were laid. The grade here is 12-14 feet wide. No rails or ties are present. A modern two-track road follows the grade, but diverges from it at the drainage crossing, making a short detour to the north of the grade. No associated artifacts were found in the vicinity. According to Gifford (2004), the logging railroad system documented on the Coconino National Forest by Stein (2006) is significant under criteria a and c for nomination to the NRHP, but the segment documented by MNA is not eligible individually due to lack of intact construction integrity, particularly the lack of ties or rails. This segment falls into Class 7 of the Coconino National Forest's classification system for logging railroads.

03-04-02-5289

This site consists of two small but dense concentrations of historic trash (Locus A and B) located in an open forest setting. Locus A measures approximately 6 x 5 m and contains the vast majority of the trash in a circumscribed area with minimal dispersal. Artifacts in this concentration include approximately 20 bottles (liquor, condiments, syrup) and 300 cans (milk, vegetable, fruit, meat). Numerous partial bottles exhibit maker's marks that indicate manufacture between 1945 and 1955. Locus B measures 8 x 6 m and contains far fewer artifacts that are more widely dispersed. Artifacts here include about 50 cans, a tire rim from a 1930s-1940s auto, and metal straps from a barrel or crate. Diagnostic milk cans indicate a date after 1950, but the condition of the artifacts is similar to those in Locus A and it seems likely that the entire site assemblage is comparable in age. Glass artifacts are mostly broken and cans are rusted and most have been smashed and flattened. It is unclear whether the artifacts resulted from camping at this location or whether they were dumped here. Although the site retains all aspects of integrity except setting, there is minimal data potential remaining in the artifact assemblage and little potential for buried features due to the camping or dumping activity that created the site, so the site is not eligible for nomination to the NRHP.

03-04-02-5292

This small historic camp is marked by a concentration of about 30 rusted food and milk cans, 2 broken bottles, crown caps, two stove pipe segments, and an auto gasket. There is no evidence of thermal features but a wall tent was probably present based on the stove pipe segments. Artifact types suggest the camp was used in the early 1950s by a small number of people. The site area is covered with tree duff, so additional artifacts may be present. The site retains all aspects of integrity but lacks research potential or scientific significance and so is not eligible for the NRHP.

03-04-02-5295

This small concentration of historic trash occurs located in the bottom of a north-trending drainage. The site presents no evidence of structural or thermal features and appears to represent a single dump episode of household trash, although no road is near the site. Most artifacts are partially buried by tree duff and additional items may be buried. Artifacts include a metal bucket lid, metal crate straps, a coin box from a vending machine, the metal frame from a child's car seat (type that hangs over the back of the front seat), two chunks of concrete, two jelly jar glasses, a clear glass jar, a porcelain bowl fragment, and about 10 milk, food, and coffee cans. Artifact technology indicates the trash dates to the 1950s or early 1960s. The site retains all aspects of integrity except setting but lacks research potential or scientific significance and so is not eligible for the NRHP.

03-04-02-5398

This site consists of a dense concentration of cans, bottles, and other trash that was piled under a small oak grove. Artifacts are mostly buried by deep tree duff and only about 100 are visible for inventory, but many more appear to be buried. Cans include containers for meat, fish, vegetables, coffee (*Columbus* brand), beer (*Country Club* brand), and peanuts (*Planter's Salted Peanuts* and *Circus Peanuts*). Bottles held honey, condiments, and liquor. A kerosene lamp fuel reservoir is also present. There is no evidence of features but it seems likely that tents or other shelters were present, as the density of trash suggests numerous days of occupation. The artifact types give a date of 1950-1965, which post-dates the logging activity in this area, but the large number of cans and the large size of many suggest the camp served numerous people. The site retains all aspects of integrity except setting but lacks research potential or scientific significance and so is not eligible for the NRHP.

03-04-02-5299

This small but dense historic trash concentration is probably the result of a single dumping episode. A two-track road passes within 50 m north of the site, which is just north of the section line fence. The dump contains a variety of household trash, mainly several hundred food and beverage cans and bottles, but also an automobile headlight and some miscellaneous rubber and metal fragments. Maker's marks and artifact morphology indicate an age of 1940-

1955. Most of the trash is piled adjacent to a large fallen ponderosa, and has been minimally scattered since deposition. There is no evidence of features, further suggesting the site resulted from an episode of dumping rather than a camp. The site retains all aspects of integrity but lacks research potential or scientific significance and is not eligible for the NRHP.

03-04-02-5302

This is the remains of a large camp, probably related to logging in the early 20th century. The site contains a large number of cans and other metal artifacts, as well as a few bottles and dishes, barrel/cask straps, a thimble, and a hurricane lamp reservoir. In addition to identifiable cans, the site area exhibits many hundred small fragments (less than 3" in size) of rusted and eroded cans. Locus A, at the west end of site, contains an extremely dense concentration of cans but also bottles; this area appears to be the primary camp dump. Feature 1 is an excavated pit that measures 5 x 3 feet and was probably used to burn and bury trash. Limestone rocks around the pit edge are fire reddened and much of the can debris in this vicinity is highly fragmented, likely due to accelerated decomposition after burning. Several small pieces of melted glass are present. The pit is at least 2 feet deep and numerous artifacts are visible but partially buried. Locus A contains the greatest concentration of artifacts and widest variety of types, and demonstrates that a large number of people occupied the camp because most cans are quart or gallon size for "industrial" cooking. Cans contained foods such as Karo syrup, tea or cocoa, evaporated milk, fruit and vegetables, and condiments. There is a surprising lack of meat cans for a work crew, so perhaps fresh meat was served. There is also a notable lack of beer or liquor bottles, tobacco tins, and coffee cans; fewer than 10 of each kind were found at the entire site. Other than a glass lamp reservoir, the only utilitarian items were a few pieces of crockery and stoneware, a few metal bowls or saucers and several metal bands from barrels or crates. Locus B, at the east end of site, has a moderately dense artifact scatter (ca. 1 per 3 sq m) and may have been the kitchen for the camp. There is no evidence of thermal features or tent foundations but this area is open and flat and could have accommodated a large number of temporary structures. Locus C, at the southwest end of site, is a small but dense artifact concentration, perhaps a secondary dump area. No trash pit or other features are visible. The site date was assigned based on the prevalence of milk cans dating to 1917-1929 and a relative abundance of SCA glass, as well as the highly degraded condition of the cans. The date corresponds to the period between 1918 and 1923 when the area was logged by the Greenlaw Lumber Company (Stein 2006:18). The site retains all aspects of integrity except feeling and material (due to the decomposition of metal artifacts), but lacks scientific research potential and is not eligible for the NRHP. One clear glass liquor bottle lying beneath a tree at the south end of the site was embossed with "FEDERAL LAW FORBIDS…", giving a manufacture date of 1932 – 1964; this must be a post-occupation addition to the camp.

03-04-02-5315

The historic artifact concentration at this multi-component site covers approximately 32 sq m. The prehistoric component of the site is eligible for nomination to the National Register of Historic Places. Artifacts consist of 15 beer and liquor bottles and 31 metal food containers, suggesting a brief episode of occupation. Milk cans and Miller High Life bottles were the most plentiful artifacts. Based on intact artifact morphology, the camp was occupied between 1952 and the early 1970s.

Discussion of Post – 1850 Resources and Themes

Most of the post-1850 sites previously documented and encountered during the supplemental survey relate to extractive endeavors such as logging and ranching. At least five camps contain features and artifact assemblages indicating they were bases of operation for large numbers of people, probably related to logging. Other camps appear to have been more briefly occupied and are characterized by smaller artifact assemblages and occasional evidence of informal structures. Hearths at historic camps are typically lined with unmodified limestone rocks and frequently contain pieces of melted glass and burned metal fragments. Charcoal in these features consists of large pieces and appears quite fresh, especially compared to the small charcoal flecks or smears seen on prehistoric sites. None of the documented camps have been linked to particular people or events that would elevate their significance; these sites instead offer a cohesive data set that illuminates patterns of land use in the region around Walnut Canyon.

Segments of at least three logging railroads occur within the SRS area (Stein 2006). The Greenlaw Lumber Company, owned by the Arizona Land and Timber Company, operated the Greenlaw South line on the north side of Walnut Canyon between 1918 and 1923. This line access the area between the modern Interstate 40 and the canyon, including Campbell Mesa, the Bottomless Pits, and Fisher Point. On the south side of Walnut Canyon, the Flagstaff Lumber Manufacturing Company (FLM; later the Flagstaff Lumber Company) maintained lines to the Clark Valley – Howard Mountain, Mormon Mountain – Mormon Lake, and Anderson Mesa areas; the latter included the massive project to construct the incline, the only feature of its type built in the Flagstaff area. Beginning in 1909, the FLM accessed some of the more rugged topography in the area to obtain timber, often using the best in ‘modern technology’ of the time.

The documented logging railroad segments in the study area range from in-use two-track roads with occasional areas supported by ballast foundation to the massive cut and fill surface of the Anderson Mesa incline. Most segments lie between these extremes, exhibiting sections of raised grade that can be followed for several hundred meters, the eroded remains of causeway grades built to cross drainages, and occasional sections where ties were left to rot but are still visible. Associated artifacts typically include a few railroad spikes or plates, as well as the partially preserved ties. Stein’s (2006) comprehensive documentation of the logging railroads on the Coconino and Kaibab National Forests resulted in a Multiple Property Nomination to the NRHP, which demonstrated the significance of the logging industry in northern Arizona. None of the segments documented within the study area to date are considered eligible, but they are all contributing elements of that multiple property nomination.

The logging industry provided one of the earliest economic bases for the Flagstaff area (Cline 1976; Stein 2006). Although the ethos of the early twentieth century did not promote sustainable harvesting practices, the industry supported a significant regional work force from the late 1890s through the 1960s. Logging was an ingrained vocation for many people in the communities of Flagstaff and Williams, exemplified by the choice of a lumberjack as the mascot for Northern Arizona University (then Arizona Teacher’s College).

Ranching provided another economic cornerstone of the Flagstaff area, beginning with the opportunity to supply meat to burgeoning communities in the late nineteenth century. Large ranches, such as the CO Bar ranch operated by the Babbitt family, offered employment for hundreds of men and added a significant amount of revenue to the economy (Smith 1989). The archaeological signature of ranching may be less ‘massive’ and less visible than logging due to the more indistinct nature of the associated camps, but there is no doubt that some of the sites documented in the study area relate to this industry.

Another activity represented by several historic sites and IOs is recreation, including hunting and visiting the spectacular ruins of Walnut Canyon. Again, few of the sites exhibit features or artifacts that clearly tie them to a specific activity, but it is likely that many of the short-term camps result from these activities; the presence of hunting blinds (IO 69) fits this category. Proximity of the Walnut Canyon area to Flagstaff certainly influenced the ephemeral nature and small artifact assemblage of many historic camps, as there was little need for large expeditions in an area easily accessed by roads north and south of the canyon. Access to Walnut Canyon from Flagstaff was originally from the south, through Clark Valley, but a more direct route connected the town with the north rim by 1884. The current Forest Road 303 was in existence by 1908, and by 1915 was recognized as part of the Ocean to Ocean Highway that extended from New York to Los Angeles. Work crews from the CCC improved FR 303 in 1942, providing access to a broad swath of forest terrain as well as the canyon.

Figure 5.1. Area W Newly Discovered and Recorded Archaeological Sites.

Figure 5.2. Area W Archaeological Sites Including Previously Recorded Sites.

Figure 5.3. Newly Discovered and Recorded Archaeological Sites in Areas X, Y, and Z.

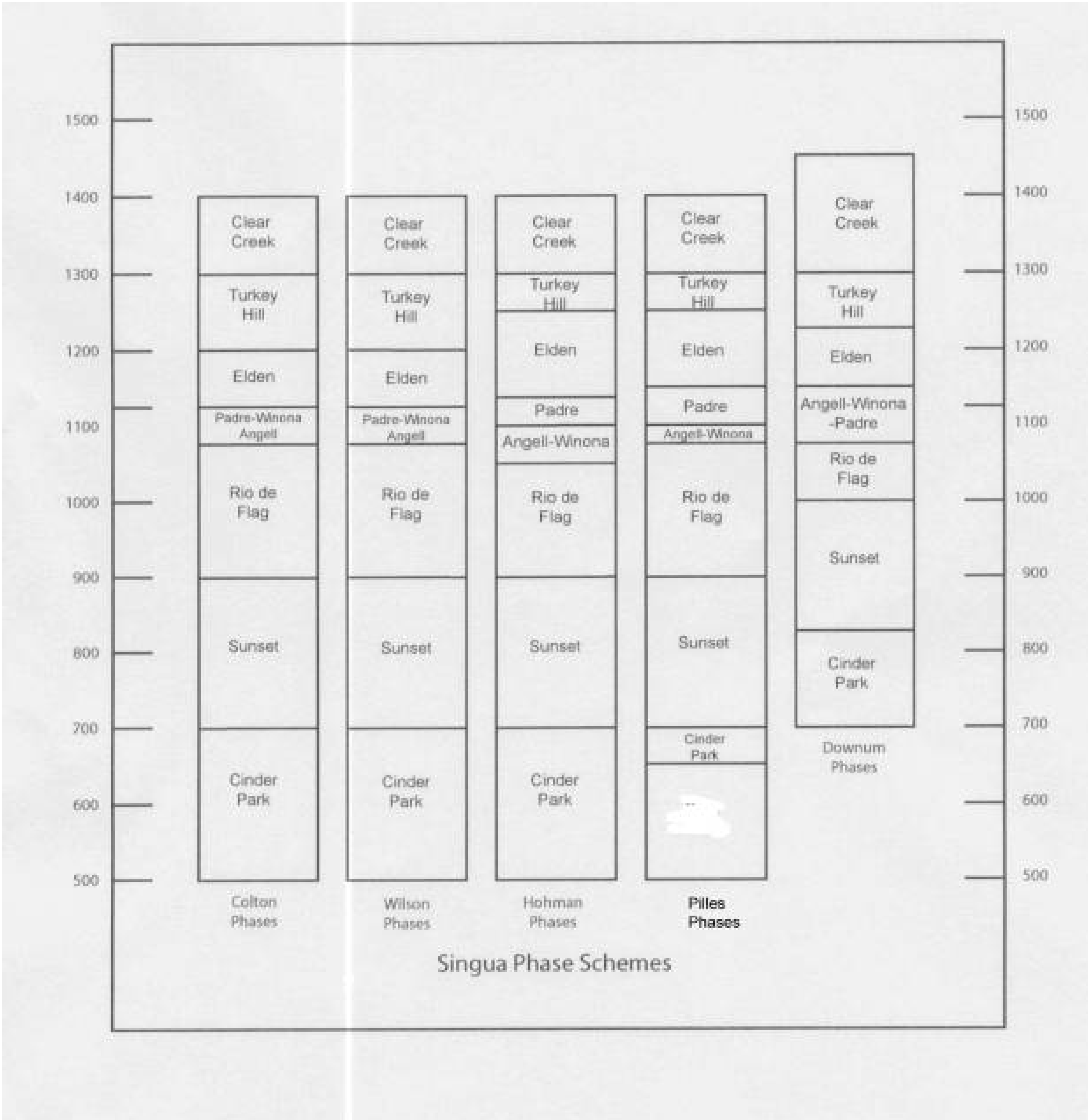

Figure 5.4. Various Prehistoric Ceramic Period Chronologies that have been Articulated by Previous Researchers for the Flagstaff area (after Acord 2005: 195; Figure 50).

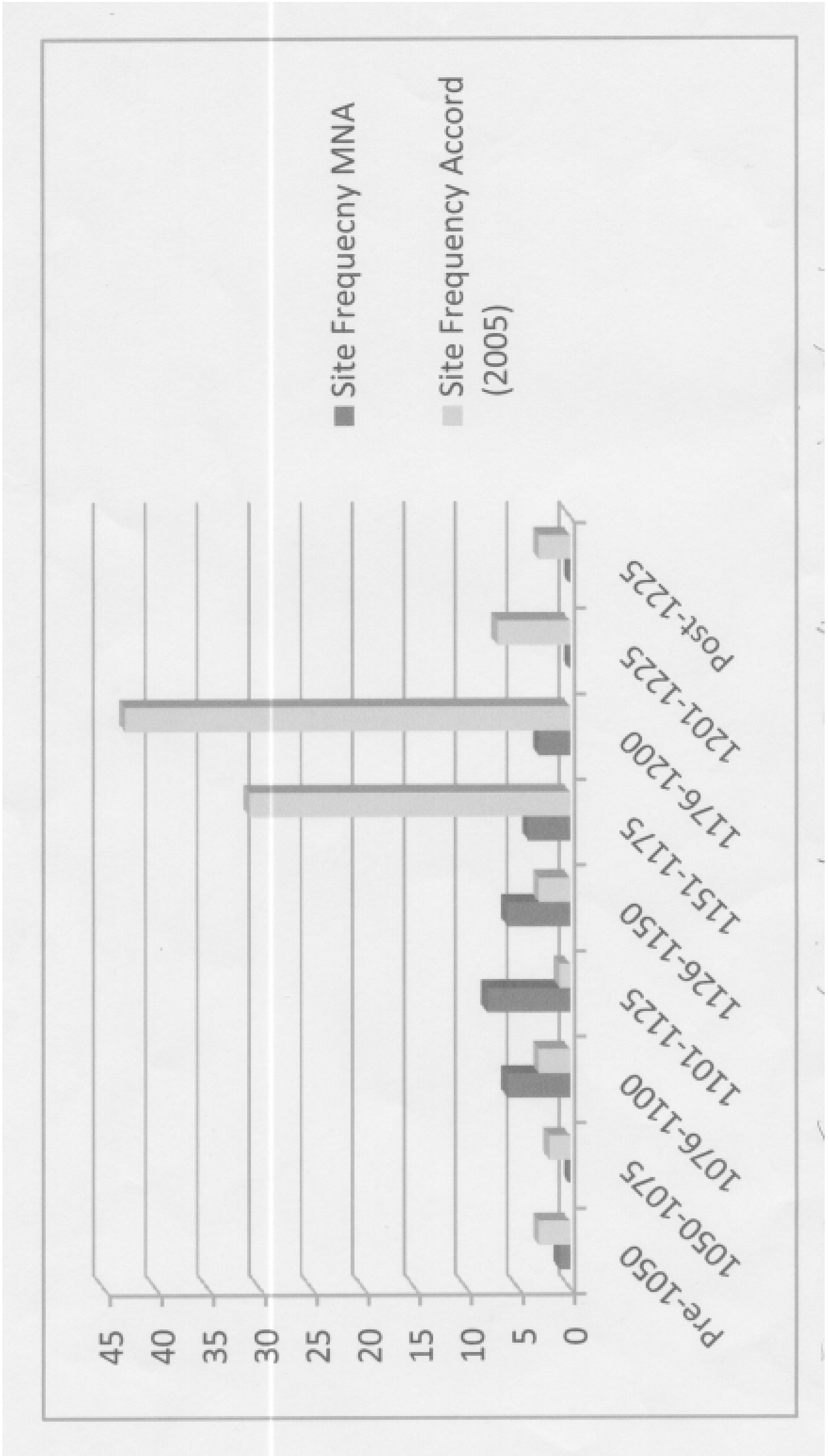

Figure 5.5.Frequency of Sites Dating to Twenty-Five Year Intervals; Sites Dated by the Mean Ceramic Dating (MCD) Method; Dark Bars are Sites Recorded by MNA in the Study Area; Gray Bars are Sites within WACA dated by Acord (2005).

Table 5.1. Summary of the 68 Sites and 72 Components Recorded or Re-Recorded by MNA in Units W, X, Y, and Z.

CNF site	**Temp. comp.**	**Cultural Affiliation**	**Temporal Period**	**INFRA type**	**NRHP Status**	**NRHP Criteria**
02-5325	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	CLIFF DWELLING	Eligible	D
02-5326	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	CLIFF DWELLING	Eligible	D
02-5327	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	CLIFF DWELLING	Eligible	D
02-5328	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5329	PRE	NORTHERN SINAGUA	ANGELL-WINONA	CLIFF DWELLING	Eligible	D
02-5330	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5331	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5332	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5333	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5334	PRE	PROTOHISTORIC (UNSPECIFIED)	UNKNOWN	CLIFF DWELLING	Eligible	C, D
02-5335	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
02-5336	PRE	NORTHERN SINAGUA	UNKNOWN	CLIFF DWELLING	Eligible	D
NA 7823	PRE	PREHISTORIC (UNSPECIFIED)	UNKNOWN	CAVE	Eligible	D
NA 5607	PRE	PREHISTORIC (UNSPECIFIED)	UNKNOWN	CAVE	Eligible	D
02-1357	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	ARTIFACT SCATTER	Eligible	D
02-4200	HIS	OTHER HISTORIC	HISTORIC-STATEHOOD	RAILROAD TRACK/BED	Not Eligible	
02-4640	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	ARTIFACT SCATTER	Eligible	D
02-5280	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	ARTIFACT SCATTER	Eligible	D
02-5281	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5282	PRE	NORTHERN SINAGUA	ELDEN	ARTIFACT SCATTER	Eligible	D
02-5283	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5284	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5285	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5286	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5287	PRE	NORTHERN SINAGUA	Padre	PUEBLO: 1-2 ROOMS	Eligible	D

CNF site	Temp. comp.	Cultural Affiliation	Temporal Period	INFRA type	NRHP Status	NRHP Criteria
02-5288	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	ARTIFACT SCATTER	Eligible	D
02-5289	HIS	OTHER HISTORIC	HISTORIC-RECENT	TRASH SCATTER	Not Eligible	
02-5290	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5291	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	FIELD HOUSE	Eligible	D
02-3881	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-3882	PRE	NORTHERN SINAGUA	ANGELL-WINONA	PUEBLO 1-2 ROOMS	Eligible	D
02-5292	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	TRASH SCATTER	Not Eligible	
02-5293	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	AGRICULTU RAL FIELD	Eligible	D
02-5294	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	FIELD HOUSE	Eligible	D
02-5295	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	TRASH SCATTER	Not Eligible	
02-5296	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5297	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5298	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	ARTIFACT SCATTER	Not Eligible	
02-5299	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	TRASH SCATTER	Not Eligible	
02-5300	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ROCK FEATURE	Eligible	D
02-5301	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5302	HIS	OTHER HISTORIC	HISTORIC-STATEHOOD	TRASH SCATTER	Not Eligible	
02-5303	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5304	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-0216	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-3576	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-3576	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	CAMPSITE	Not Eligible	
02-4774	PRE	NORTHERN SINAGUA	ANGELL-WINONA	PUEBLO 1-2 ROOMS	Eligible	D
02-4775	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D, E
02-5305	PRE	NORTHERN SINAGUA	ANGELL-WINONA	AGRICULTU RAL FIELD	Eligible	D
02-5306	PRE	NORTHERN SINAGUA	UNKNOWN	AGRICULTU RAL FIELD	Eligible	D

CNF site	Temp. comp.	Cultural Affiliation	Temporal Period	INFRA type	NRHP Status	NRHP Criteria
02-5307	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5308	PRE	NORTHERN SINAGUA	ANGELL-WINONA	PUEBLO 1-2 ROOMS	Eligible	D
02-5309	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5310	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5311	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5312	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D
02-5313	PRE	NORTHERN SINAGUA	PRE-ERUPTIVE	ARTIFACT SCATTER	Eligible	D
02-5313	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5313	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	CAMPSITE	Eligible	D
02-5314	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5314	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	CAMPSITE	Eligible	D
02-5315	PRE	NORTHERN SINAGUA	ANGELL-WINONA	SHERD SCATTER	Eligible	D
02-5316	HIS	UNKNOWN HISTORIC	HISTORIC-RECENT	ARTIFACT SCATTER	Eligible	D
02-5317	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5318	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5319	PRE	NORTHERN SINAGUA	ANGELL-WINONA	PUEBLO 1-2 ROOMS	Eligible	D
02-5320	PRE	NORTHERN SINAGUA	POST-ERUPTIVE	FIELD HOUSE	Eligible	D
02-5321	PRE	ARCHAIC	ARCHAIC (UNSPECIFIED)	LITHIC SCATTER	Eligible	D
02-5322	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5323	PRE	NORTHERN SINAGUA	ANGELL-WINONA	FIELD HOUSE	Eligible	D
02-5324	PRE	NORTHERN SINAGUA	ANGELL-WINONA	ARTIFACT SCATTER	Eligible	D

[1] = E equals eligible; N equal not eligible.

Table 5.2. Summary of Archaeological Sites in Area W.

Description	**CNF# (NA#)**
4 rooms under alcove	02-5325
1 room under alcove	02-5326
2 rooms under alcove	02-5327
1 room under alcove	02-5328
2 rooms under alcove	02-5329
1 room under alcove	02-5330
1 room under alcove	02-5331
1 room under alcove	02-5332
1 room under alcove	02-5333
Pictographs and grinding slab in large alcove	02-5334
2 adjacent alcoves, has 1 room in eastern alcove	02-5335
3 rooms under alcove	02-5336
Paho Cave	02-0549 (NA7823)
Split Twig figurine site; slab-lined cist in alcove	02-0519 (NA5607)
Pictographs in alcove with a bedrock metate	05-0141 (NA19035)

Table 5.3. Mean Ceramic Dates for MNA Sites.

AR-03-04-02-	Site Mid-point Date (AD): WMCD
5315	913
5286	1088
5285	1088
5291	1088
5331	1088
3882	1089
5284	1094
5283	1114
3881	1115
5290	1117
4640	1120
5318	1125
5312	1125
5287	1125
5308	1125
5288	1130
5297	1132
5303	1133
5301	1133
5319	1135
5300	1144
5282	1151
5310	1151
5322	1152
4775	1158
216	1188
4774	1188
5309	1188
3576	cnd
5294	cnd
5296	cnd
5304	cnd
5311	cnd
5314	cnd
5316	cnd
5317	cnd
5324	cnd
5325	cnd
5326	cnd
5328	cnd
5329	cnd
5305	cnd

Table 5.4. Summary of MNA Historic Sites.

Site Number (AR-03-04-)	Type	Age	Features	Cans	Glass	Milled lumber	Metal	Other
03-04-02-4200	Railroad grade and culvert	1918-1923	grade, causeway, culvert					
03-04-02-5289	Camp/trash scatter	1945-1955	none	X	X		X	auto tire rim
03-04-02-5292	Camp	early 1950s	none	X	X		X	stove pipe, auto gasket
03-04-02-5295	Trash scatter	1950s-early 1960s	none	X	X		X	child car seat, coin box
03-04-02-5298	Camp	1950-1965	none	X	X			kerosene lamp
03-04-02-5299	Trash scatter	1940-1955	none	X	X		X	auto headlight
03-04-02-5302	Logging camp	1917-1930	thermal pit	X	X		X	kerosene lamp
03-04-02-5315	Trash scatter		none	X	X	X	X	

Chapter 6: Prehistoric Site Spatial Analysis

The goal of this analysis is to observe, quantify, and visualize some of the variables salient in the archaeological site distribution in the area surrounding Walnut Canyon National Monument.

Project area and previous work

The first step in the descriptive analysis was to aggregate and examine the core data from which the analysis would be founded. The baseline area for analysis in the WACA SRS was defined as a 30,903 acre area surrounding the current 3,567 acre Walnut Canyon National Monument resulting in a total area of 34,470 acres. This area includes land managed by the Coconino National Forest (CNF), the National Park Service (NPS), State of Arizona, and a number of private in-holdings. Within this area, a total of 12,815 acres have been evaluated during previous archaeological projects, representing 41% of the study area (Figure 6.1).

In order to better place the study area within a regional frame of reference, a considerably larger area was defined to encompass an additional 261,649 acres. Combined with the study area this regional view provides a total of 292,552 acres to evaluate. Of this total regional study area, roughly 70,000 has been surveyed for archaeological sites during previous projects, representing 24% of the entire study area. No archaeological sites were considered outside of this regional study area.

Site distribution

The site location data was derived from three primary sources: the CNF, the NPS, and from field work conducted by MNA. At its most fundamental, the locational data consists of a series of point layers each either describing the location of the datum or the centroid of a recorded archaeological site. The basic level of archaeological description is the site point. Each site point is defined by a site number, though depending on the agency involved in managing the land on which the site fall, each site may be described by as many as four separate numbers.

Of the sites evaluated in this study, the most (n=3467) fall within property administered by the Coconino National Forest. Given the high density of sites, the CNF series of site numbers was given predominance as the primary key for the organization of site data. Though many of these sites also have Arizona state or MNA series site numbers, the CNF number was used as the preferred primary key for the organization of site data. This is an important consideration to avoid the duplication of site numbers within the data set. Conveniently, all of the sites identified during the field portion of the SRS project (n=56) were recorded using the CNF series, making integration a simple task.

The remainder of sites that lack a CNF site number can be found on land administered by the NPS. These sites (n=508), identified by a site number predicated on the NPS properties in which they are found, presented a unique problem to integration with the remainder of the sites. In order to aggregate all of the sites using two disparate site numeration formats additional fields had to be added to each site level data set to isolate the numerical portion of the site number and to identify the administrative agency responsible for assigning that number. Once these fields were in place and correctly populated it was then possible to join the multiple point layers into a single file that contains all previously recorded sites within the regional study area. The subsequent regional-level site layer contains a total of 4031 previously recorded archaeological sites.

Combining the attribute data provided an additional challenge due to the inherent differences in how each data set was organized and populated. In evaluation of the CNF and NPS site layers, two very similar data fields are most consistently present: cultural affiliation and site type. Differences in nomenclature were addressed through the addition of two summary fields to the regional-level site layer to which descriptive data was aggregated from internal fields and database table joins.

At this point in the process, the site records include all sites recorded in the regional study area from Paleoindian to recent historic occupations. In order to focus the analysis on the Northern Sinagua occupation the site layer was filtered using the cultural affinity field so that only Northern Sinagua and contemporary cultural groups (IE Cohonina, Puebloan, Anasazi, etc) are represented. This included eliminating the 595 records that have either no data or unknown affiliation, as well as the 48 records that listed Northern Sinagua for their cultural affinity type but had modern site types (such as railroad features or wikiups). Based on this filter process, it is assumed that all sites in the study sample are either Northern Sinagua or contemporaneous to their occupation of the region.

Given the large sample, the site-type field is critical to describing the distribution of sites in the study area. All records with a no data (either a null value or a value of “unknown”) within the site type field were eliminated resulting in a final sample population of 3,015 regional-level site records that retain typological data (Figure 6.2). However, as the site type data was aggregated from multiple source agencies, it was necessary to standardize the observations listed within the attribute table before continuing with analysis. An additional site type summary field was added to the dataset in order to constrain the diverse typological observations into a few logical classes. These classes were refined to group all habitation sites, all predominantly agricultural sites, and a catch-all category that includes all ceremonial sites, rock alignment sites, rock art sites, and other sites that are more difficult to fit into a regional occupation regime (see Table 6.1).

As the largest portion of the data was contributed by the CNF the interpretation of their site-type regime was essential to the assumptions used to define the site type classes. Specifically the habitation class includes all sites listed as artifact scatter sites based on the assumption that artifact scatters are the regional indicator of the presence of buried pit house structures predominantly utilized among the Northern Sinagua (*CNF INFRA site form)*. Alternately, given the temporary nature of typical field house structures their presence are commonly inferred to be associated with agricultural activities and are thus included with agricultural sites here.

Finally, it is of note that no effort whatsoever was made to verify the data used in this sample and it is assumed that all attributes are correct and accurate for each of the sites that are recorded within the study area. Though it is well beyond the scope of this project any finer resolution questions concerning cultural, temporal, or typological affiliation of these sites will require a detailed sample and re-attribution of site data based on the original site cards and project reports from which the data are derived.

Nearest Neighbor Analysis

The origin point for this analysis is to evaluate the basic statistical tenancies of the site point array in order to gain some basic understanding of its spatial distribution. The nearest neighbor analysis results in some basic statements about the pattern in comparison with an independently random (stochastic) pattern. While one can observe from the site distribution that patterns may be present, quantification using statistical analysis and comparison against a definable baseline stochastic pattern presents a repeatable method to verify observed trends.

The goal of the Nearest Neighbor statistics is to quantify the distance between each of the points in the pattern and establish the mean of these combined distances as a ratio index by comparing it with the expected mean of a stochastic model. The subsequent test results speak to the likelihood that the observed pattern is random, as well as to the pattern's degree of clustering or dispersion. The Average Nearest Neighbor summary for the 3,105 sites in the regional study area return an observed mean inter-site distance of 168 meters versus an expected mean distance of 312 meters (of the independently random model), providing a Nearest Neighbor ratio of 54%. In essence, this suggests that the observed sites are considerably closer to one another than described in the stochastic model of the same sample size and area. In short, this means that the sites in the sample tend to be closer to one another than one would expect within a random pattern.

The Nearest Neighbor test also produced a Z-score of -48.52 deviations from sigma and a p-value of 0.000000. The Z-score is an indicator of point distribution, where the zero baseline lies at the mean of the random model and deviations below and above are indicative of either clustering or dispersion respectively. In this case the extremely low sigma value of the Z-score is indicative of a highly clustered point pattern that is well beyond what one would expect from a random pattern. Finally, the p-value is an index of the probability that the observed point pattern is a result of a stochastic pattern, and in this case, the Nearest Neighbor test indicates that the regional-level site sample has less than a 1% chance of being a random distribution.

One question that arises from the results of the Nearest Neighbor test is how different classes of sites relate to one another. In order to answer this, the sample is broken out by its aggregated site classes and the test is rerun on each (Table 6.2). Based on the results of the Nearest Neighbor test by class, each demonstrates Ratio values less than one, suggesting that clustering is present within each pattern. The low p-values demonstrate that the Z-scores are more than three standard deviations from the mean and that we can reject the null hypothesis that the patterns are the result of stochastic pattern.

In contrast, the Z-scores also reflect differing degrees of clustering whereby the habitation sites would appear to be much more tightly clustered than those of the other classes. Alternately, the higher Z-score and Nearest Neighbor score of the “Other” denotes a greater degree of dispersion, which is largely what one should expect from a typological class so arbitrarily defined as to have very little actual meaning. As such, the “Other” class will be excluded from additional spatial analysis due to its inherently arbitrary nature.

Cluster analysis

While the Nearest Neighbor test would concede the instinctual observation that the sample sites are not random, it neither addresses how the sites are clustered nor what factors are driving the distribution. A powerful method for modeling pattern density and dispersion is Kernel Density Estimation (KDE), which creates a hypothetical surface that both visualizes a “point pattern to detect hot-spots” and continuous “estimates of the local intensity of any spatial process” (O'Sullivan and Unwin 2003:86).

The base assumption of the cluster analysis pattern was that observable clusters would correspond, at least roughly, with the distribution of known “polity” sites that have long been suspected to have played a major role in Sinagua site distribution within the regional study region (Wilcox, personal communication, 2011; see also Chapter 3) – (Figure 6.3). In this case, KDE is applied with the goal of identifying observable clusters of sites within the regional study area. To achieve this goal, the subsequent KDE surface is classified into four classes that were manually sorted to reflect all areas with fewer than 0.05 sites per acre, between 0.05 – 0.10 sites per acre, between 0.10 – 0.25 sites per acre, and those with more than 0.25 sites per acre. The lowest class reflecting densities below 0.05 sites per acre were then excluded as background noise, largely for the sake of clarity and to highlight site clustering of densities beyond 0.05 sites per acre. The KDE surfaces were then converted to isolines in order to facilitate comparison between each density layer. KDE surfaces and accompanying isolines were constructed for the distribution of all sites within the regional study area, as well as for the agricultural sites and habitation site patterns.

In examination of the results of the KDE surface defined for all sites in the regional area (Figure 6.4) one can clearly make out at least eight areas with site densities greater than 0.1 site per acre (or one site every ten acres). Also notable is the fact that only two of these areas correspond to the distribution of Sinagua “polity” sites, Walnut Canyon and Elden Pueblo. While it is likely that this discontinuity occurs as a result of the incomplete survey distribution it is equally likely that it comes as a result of ambiguity introduced by differing patterns present in the dataset. A comparison of the KDE surfaces generated for the habitation and agricultural sites seems to confirm this observation (Figures 6.5 and 6.6) , where the clustering associated with each class only exhibit noticible overlap in the Walnut Canyon and Elden Pueblo areas. Also notable is the paucity of high-density agricultural areas in the regional study area, though this may have more to do with the inconsistency and difficulty with which these sites are identified in the field than their actual distribution.

When compared with the estimated density of the overall site pattern (Figure 6.7), the habitation site distribution demonstrates three clear areas of concentrations of over 0.1 sites per acre (one site per ten acres). Curiously, only one of these areas of high density (in this case up to between three and four sites per ten acres) corresponds with one of the hypothesized Sinagua polity sites. Further, only three observable habitation clusters correspond with the polity sites of Walnut Canyon, Turkey Hill, and Elden Pueblo. This suggests that not all of the the hypothesized polities were as influential as the habitation densities may imply. The question then becomes, what are the predominant habitation (or polity) sites within the habitation clusters identified by the KDE process?

Another means of visualizing the distribution and clustering of points is the use of Theissen polygons. Also known as proximity polygons and Voronoi Tessellations, Theissen polygons have the unique property of interpolating all available values within the study region such that the contents of each polygon is closer to its origin point than any other point in the array. Not only can this property be used to reveal value clustering, it can also be used to make observations about the regularity and concentration of the point distribution. In this case, the complete site point layer (excluding the “other site” class) was converted to Theissen polygons and then symbolized according to site type (Figure 6.8).

The ensuing map demonstrates the same site clustering patterns that were identified in KDE analysis, which can be identified as areas of tightly packed small polygons. The small size of these polygons indicates concentrated high density site distributions within these areas, suggesting intensive occupations. The mean acreage covered by each class of polygon (Table 6.3) implies that there is not a great deal of difference in the distributional density of the two classes, though this observation is likely skewed both by the distribution of known project areas in contrast to the large areas of the regional study area not yet surveyed. However, by selecting for the highest density areas, those with polygon's below the overall mean, it is possible to roughly define a tentative occupation zone within the regional study area (Figure 6.9).

The clustered site areas identified in the KDE analysis of habitation sites are also present within the occupation zone, along with a number of other clusters that were also present in the KDE surface developed from the entire regional site distribution. Also like the results of the KDE cluster analysis, the subsequent occupation zone pattern does not correspond perfectly with the hypothesized Sinagua polity sites, which suggests that the chosen sites either did not have the socio-political impact on the region that has been thought or that the aggregated site pattern reflects broader temporal trends that do not match the polities that may have been more temporally isolated than previously thought. An alternate possibility is that additional, but undocumented, polity sites may still exist in proximity to the site clusters in areas that have not yet been adequately surveyed. Based on the descriptive analysis, such sites should exist within the densely occupied portions of the zone to the north of Elden Pueblo, north of Two Kivas, and to the east of Ridge Ruin and Walnut Canyon. What the zone also reflects is the dearth of work that has been conducted in the regional study area, including the area east and northeast of Sunset Crater and south and southeast of Walnut Canyon and Ridge Ruin.

Environmental Factor Analysis

Given the highly variable terrain that defines the study region, it is logical to postulate that the environment exerted a strong influence on the distribution of sites there and that statistical evaluation of environmental traits could identify if and how much of an influence was exerted. Where the Nearest Neighbor tests establish the likelihood of cluster phenomenon, the Getis-Ord General G Function is used to reveal when “events in the pattern are closer together than expected” when compared to the stochastic pattern (O'Sullivan and Unwin, 2003. p101). This unique quality of the G Function can help to define the nature and location of shared environmental traits that may be present in the distribution of sites in the regional study area. To proceed with the G Function test, new fields describing elevation, slope, and aspect were added to the site layer and populated using a USGS Digital Elevation Model (DEM) mosaic to define the study area surface. Values were calculated for each record of the site layer based on where the site point fell upon the cell of the elevation, aspect, and slope rasters developed from the DEM. G Function tests were then observed for each of these fields to establish the presence of clustering that may be present within the values established for the site points. The results of the Getis-Ord General G Function tests is summarized in Table 6.4 and the observations of the returns are accompanied by box plot graphs to visually demonstrate the value distributions.

In examination of the returns for the elevation distribution, it is clear that the observed array of elevations is not remarkably distant from those that one would expect resulting from a fully random process. The low Z-score suggests that there is probably some spatial clustering on the lower end of the elevation range, but not enough to expect to have come as a result of highly patterned behavior. The majority of sites, those represented in the box plot (Figure 6.11) by the second and third quartile box, are concentrated between 1923 – 2086 meters AMSL (roughly 6300 – 6850ft), which is similar to that of the modern populations currently occupying modern Flagstaff today. The mean elevation of the sample lies at 2011 m (6595ft) AMSL.

The returns of the General G Function on the aspect of the site sample reflects a similar pattern. The small difference between observed and expected G scores is suggestive of minor spatial clustering by aspect among the sample sites. The Z-value indicates that the clustering that is present is predominantly found within the upper end of the range but close to the median. This would suggest that half of the sites, again demonstrated by the second and third quartile box (Figure 6.12), are concentrated in a 130° arc between 68° and 198°. In other words, this would indicate that at roughly half of the regional sites are found on landforms that are predominantly positioned to the South and East.

G function results of the slope distribution, however, relates a slightly different picture of the regional sites. The difference between the observed and expected scores is considerably higher than that found with the other traits, suggesting some pronounced clustering of sites by slope. This is confirmed by the high Z-score, which places the location of the clustering at the high end of the range. An examination of this trend with the box plot (Figure 6.13) shows a large number of extreme outliers at the high end of the range at slopes greater than 30°. While this was an initially confounding pattern, a closer inspection of these outliers revealed their locations to be almost entirely confined to the steep walls of Walnut Canyon (Figure 6.14)**.**

Therefore, in order to get a better picture of the site distribution by slope, all sites occurring at a slope greater or equal to 30° were excluded and the General G Function was reapplied to the remaining sample (Table 6.5). The resultant scores of the post-exclusion site pattern reveal a picture much more akin to that of the elevation and aspect distribution patterns. A very narrow gap lies between the observed and expected General G scores, suggesting that spatial clustering according to slope was not a predominant element of the site sample. The low Z-score also suggests that the clustering that is present is largely confined to the upper end of the range near the median. This assertion is also present in the box plot (Figure 6.15), where half of the sample (second and third quartile box) is found within a narrow range between 0° and 2°. With that said, the presence of numerous extreme outliers observed in the pre-exclusion sample is also present in the post-exclusion sample. This pattern would indicate a seemingly contradictory message where half of the sample seems to be clustered along flat ground and the remainder is dispersed broadly over the remaining landscape.

In order to better understand this distribution by slope, the remaining sample was further divided by class and the General G was run on habitation sites and agricultural sites independently. The results of the G Function go far to explain away the contradictory behavior seen in the post-exclusion sample. Among habitation sites, the disparity between the observed and expected G scores was small, pointing to a pattern that behaves much as a stochastic pattern would. The low Z-score is suggesting some clustering just above the mean in the upper end of the range. This is largely born out in the box plot (Figure 6.16), where the middle quartiles are confined to a narrow range between 1° and 5° with a mean slope of close to 4°, while the remainder are spread broadly across the range of slope values.

Within the agricultural sites a slightly different pattern is suggested by the G Function, where the G score difference is much higher, indicating a greater level of clustering. According to the Z-score, this clustering is on the upper end of the range, but still fairly close to the mean of around 3°. Fewer extreme outliers are present among the agricultural sites (Figure 6.17), though these sites are still spread broadly across the range. This describes a pattern of agricultural sites that are far more concentrated on the flatter parts of the landscape than the corresponding habitation sites that, while also clustered at less steep slopes, are more broadly distributed. As such, slope would appear to exert a greater influence on agricultural sites than on habitation sites.

Conclusions and Additional Questions

The expressed goal of this descriptive analysis within the regional study area was to simply characterize the regional distribution of Sinagua sites and identify some possible areas of localized concentration. This analysis was meant to operate as a low-resolution statistical summary and was never intended to address issues of high-resolution temporal or typological distribution or as a framework from which a predictive model is to be developed. While these analysis topics have merit, they are also so lofty as to be unrealistic goals given the current state of the base data provided by NPS and CNF. While each administrative data set represents a substantial improvement over the traditional cabinets full of paper records which have dominated the field of archaeology for decades, they are also in early developmental stages that are currently either incomplete or require additional quality assurance measures before they can be used for additional higher-resolution analysis. In their current state, only site typology and, to a much lesser degree, cultural affiliation attributes are sufficiently complete for even this crude level of descriptive analysis. As such, these are the only fields addressed during this descriptive analysis and it is assumed that these records are correctly attributed; alternately, all site records within the data set bearing either “Null” or “Unknown” values were excluded entirely from the analysis.

One of the biggest limitations of the distributional analysis presented here comes as a function of the extensive amount of aggregation that was necessary to combine disparate data sources. In many cases, many subtly different values were merged together into a general summary field for the sake of simple organization and symbolization in the analysis. The unfortunate result of such brash aggregation is the so-called Modifiable Areal Unit Problem (MAUP) which tends to arise when data is broadly summarized (O'Sullivan and Unwin 2003). The net result of MAUP is that seemingly statistically relevant returns can be dramatically altered based solely on how the underlying data is grouped together. In other words, apparently meaningful yet apocryphal observations can be contrived from the data depending entirely upon how it is organized. The effects of MAUP were the primary reason why a greater degree of resolution was not sought through further subdivision of the regional site data set in its current state, as well as being the reason why unknown and null variables were eliminated prior to analysis. Further analysis with the regional site pattern would do well to take MAUP into account through extensive data validation and standard quality assurance methodology.

Given these limitations, there are also a number of basic trends that can be drawn from the descriptive analysis exercise. Based on the Nearest Neighbor analysis, the regional site pattern can be loosely defined as a clustered pattern, where sites are more likely to be found nearby other sites than in an isolated context. While this may come as a result of the artificial concentration of sites within arbitrary survey areas, the high probability also implies an actual degree clustering of sites according to incompletely understood social, political, economic, or environmental variables.

With statistical evidence of clustered site phenomenon, the KDE and Theissen polygon methods provided two independent methods for identifying the location and extent of clustering present within the regional pattern. The mutual agreement in the returns of these two processes further substantiates the claims of focused occupations in the study region. Within the study area, both cluster visualization methods establish a concentration of habitation and agricultural sites within and to the North and East of Walnut Canyon National Monument. Placed within the regional context, this cluster of sites is both larger and more dense than any other site cluster in the surrounding area.

Lastly, the examination of basic environmental traits of the regional study area establish some basic trends. Elevation does not appear to have been a statistically relevant factor in the distribution of sites in the regional study area, with most of the sites occurring within the range of modern populations in the Flagstaff area. Aspect (or slope direction) appears to have had a greater influence on the location of sites in the region as more than half were found on landforms facing a generally southeast direction, which corresponds to the aspect in which one would expect the highest thermal potential and longest exposure during the winter months. Evaluation of the slope trends depict sites adapted to a wide range of habitats ranging from flat valleys to steep cliff walls. The bulk of the distribution however, excluding those statistical outliers found among steep terrain greater than 30°, tends to be clustered at the low end of the range among the flatter parts of the region. This preferential tendency towards level ground stands for both agricultural and habitation sites, though slightly more for the former than the latter. All in all, while environmental conditions must have had an effect on their location, it does not appear to have been the dominant variable in the distribution of sites in the regional study area.

A great deal of work remains to be done in order to extend the results of this analysis to identifying what factors most strongly influence the distribution of Northern Sinagua and contemporaneous sites in the study region. Given, the first and foremost task is to conduct more archaeological survey and to document more sites within the regional study area. Second, the existing data should be more completely compiled and validated in order to standardize the data and aggregate all recorded sites in the area. This would also imply adding data from other sources, such as Wupatki National Monument and the Arizona State Museum AZSITE database. The validation process should be focused on the verification and population of “Null” and “Unknown” values from the original site forms and field notes, as well as a systematic quality assurance study of the data to ensure at least an 80% confidence level of the key attribute fields to allow for better control of site typology, cultural affiliation, and temporal occupation during the analysis. Environmental analysis would greatly benefit from higher resolution surface model data and aerial orthography within the regional study area to produce a more accurate model of the variables that define the distribution. The logical end-goal of these data acquisition and maintenance efforts is the generation of a high resolution predictive model based on the current site distribution that could be used to not only locate undocumented sites, but to better manage development and stewardship of the rich archaeological legacy in the Sinagua region.

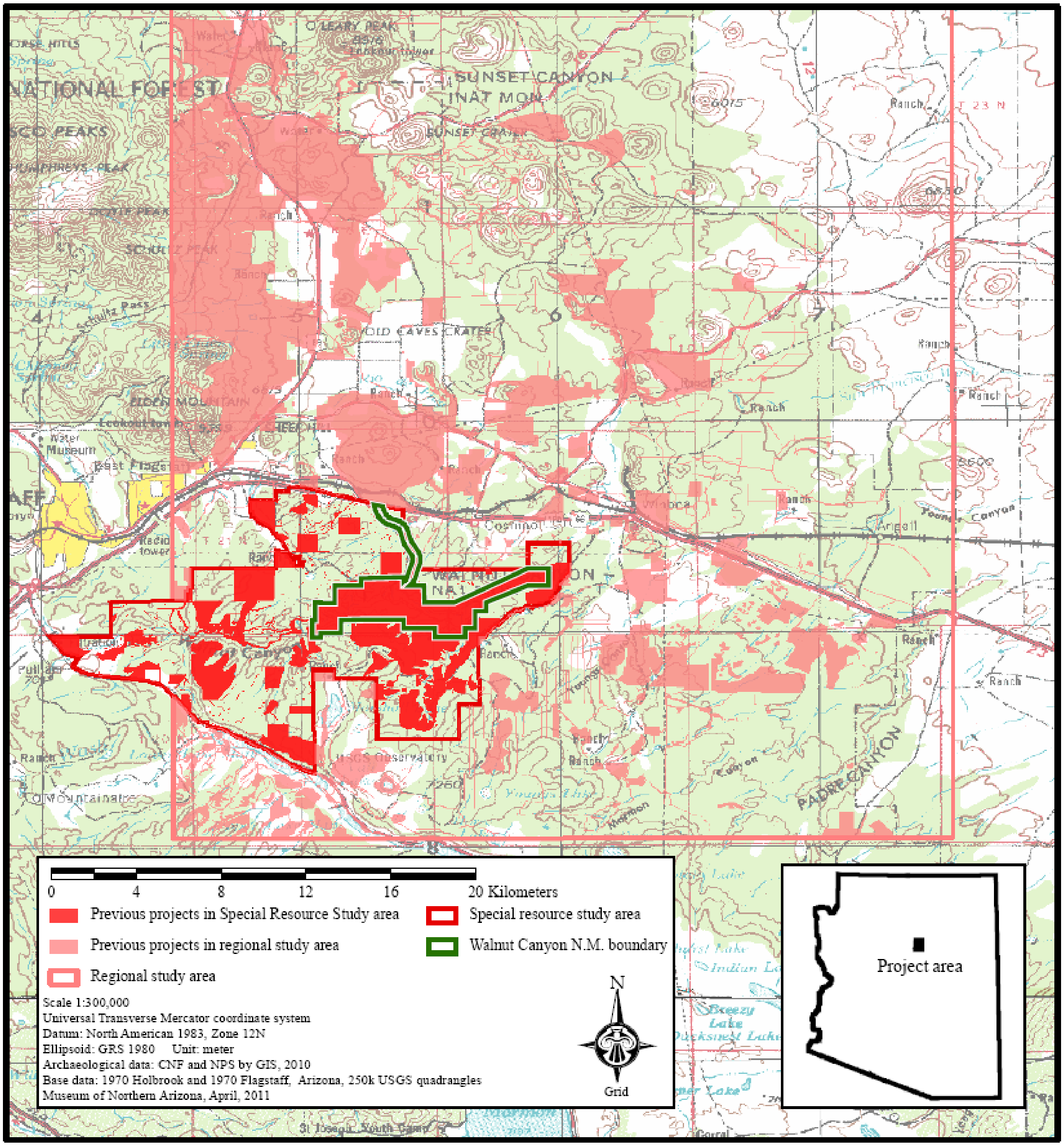

Figure 6.1. The Study Area and Regional Study Area with Previous Project Boundaries.

Figure 6.2. Distribution of Regional Sites.

Figure 6.3. Distribution of Hypothesized Northern Sinagua “Polity” Sites.

Figure 6.4. Kernel Density Estimation Surfaces Derived from Regional Site Distribution.

Figure 6.5. Kernel Density Estimation Surfaces Derived from Regional Agricultural Site Distribution.

Figure 6.6 Kernel Density Estimation Surfaces Derived from Regional Habitation Site Distribution.

Figure 6.7. Comparison of Kernel Density Estimation Derived Surfaces.

Figure 6.8. Theissen Polygon Array for Regional Agricultural and Habitation Sites.

Figure 6.9. Theissen Polygon Array Filtered for Highest Density Site Distribution.

Figure 6.10. Theissen Polygon Array within the Study Area, Filtered for Highest Site Distribution.

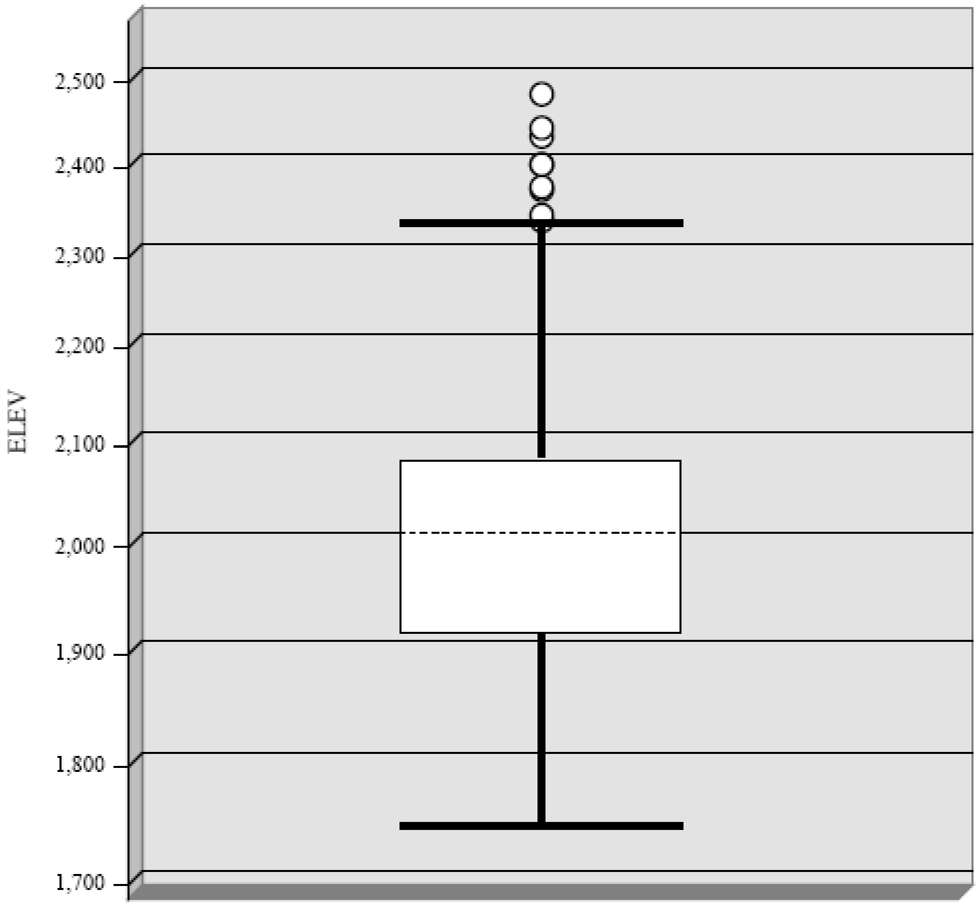

Figure 6.11. Elevation Distribution of Regional Sites.

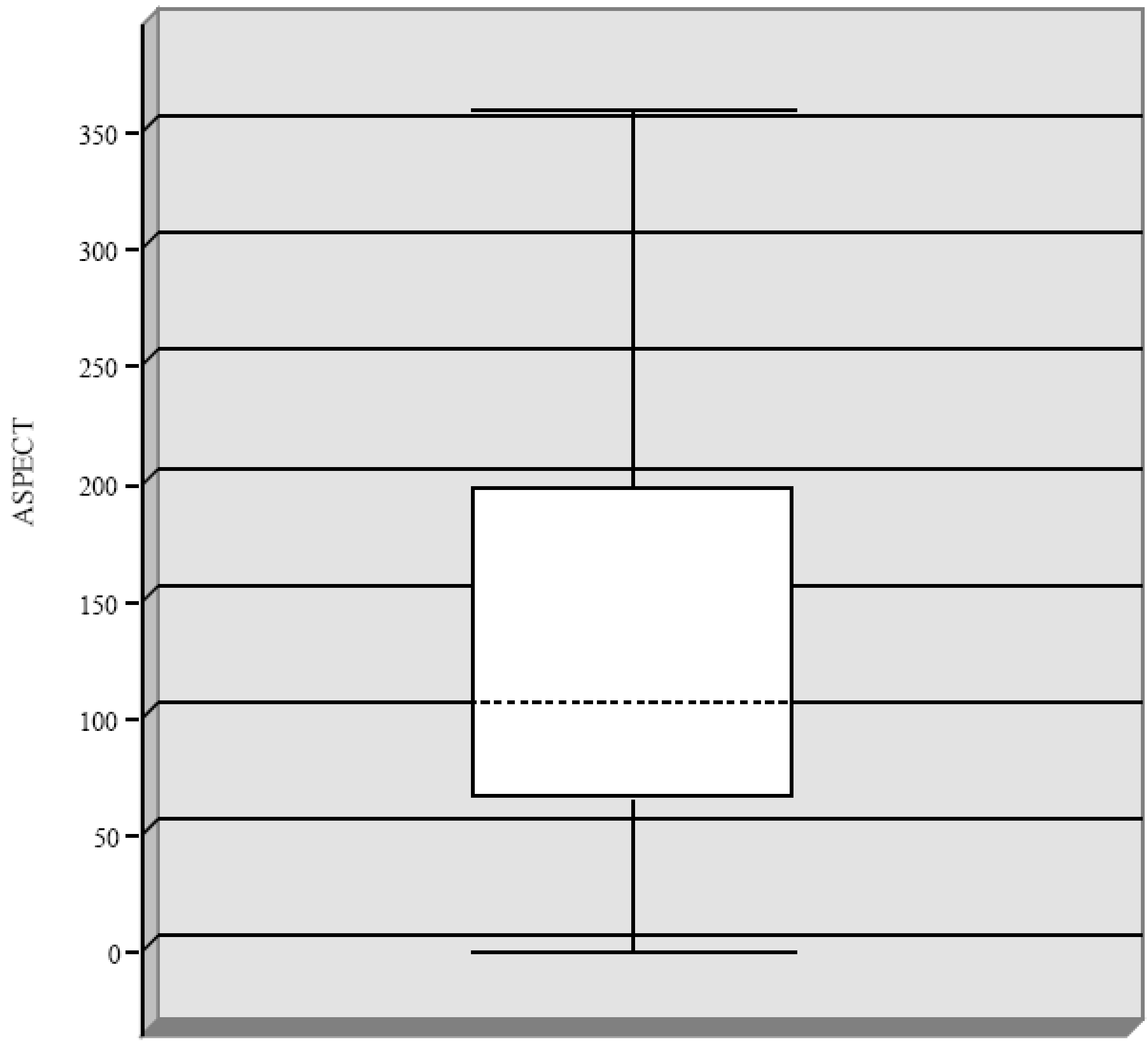

Figure 6.12. Aspect Distribution of Regional Sites.

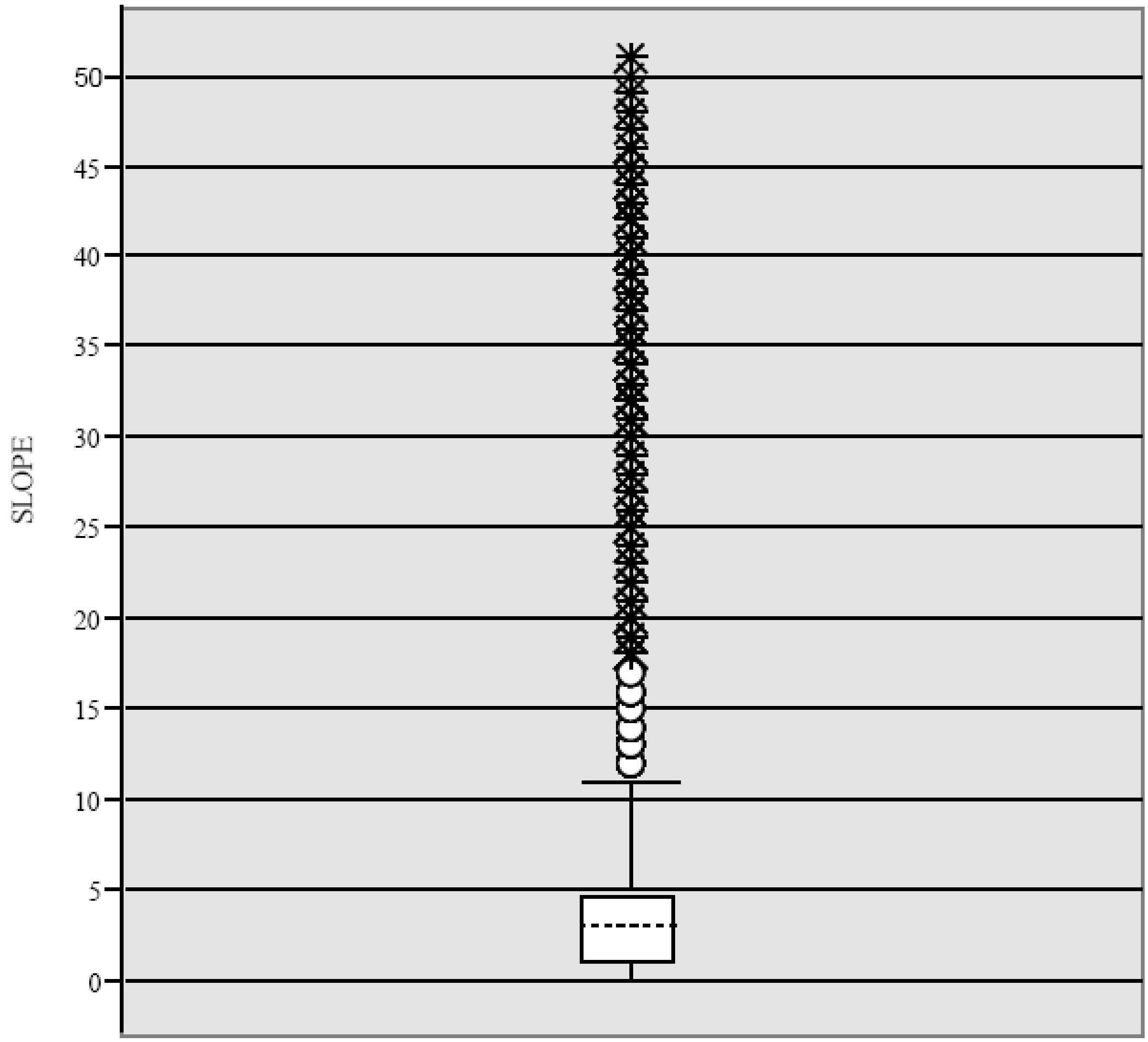

Figure 6.13. Slope Distribution of Regional Sites (Box Plot).

Figure 6.14. Slope Distribution of Regional Sites. (Excluding 30 degrees).

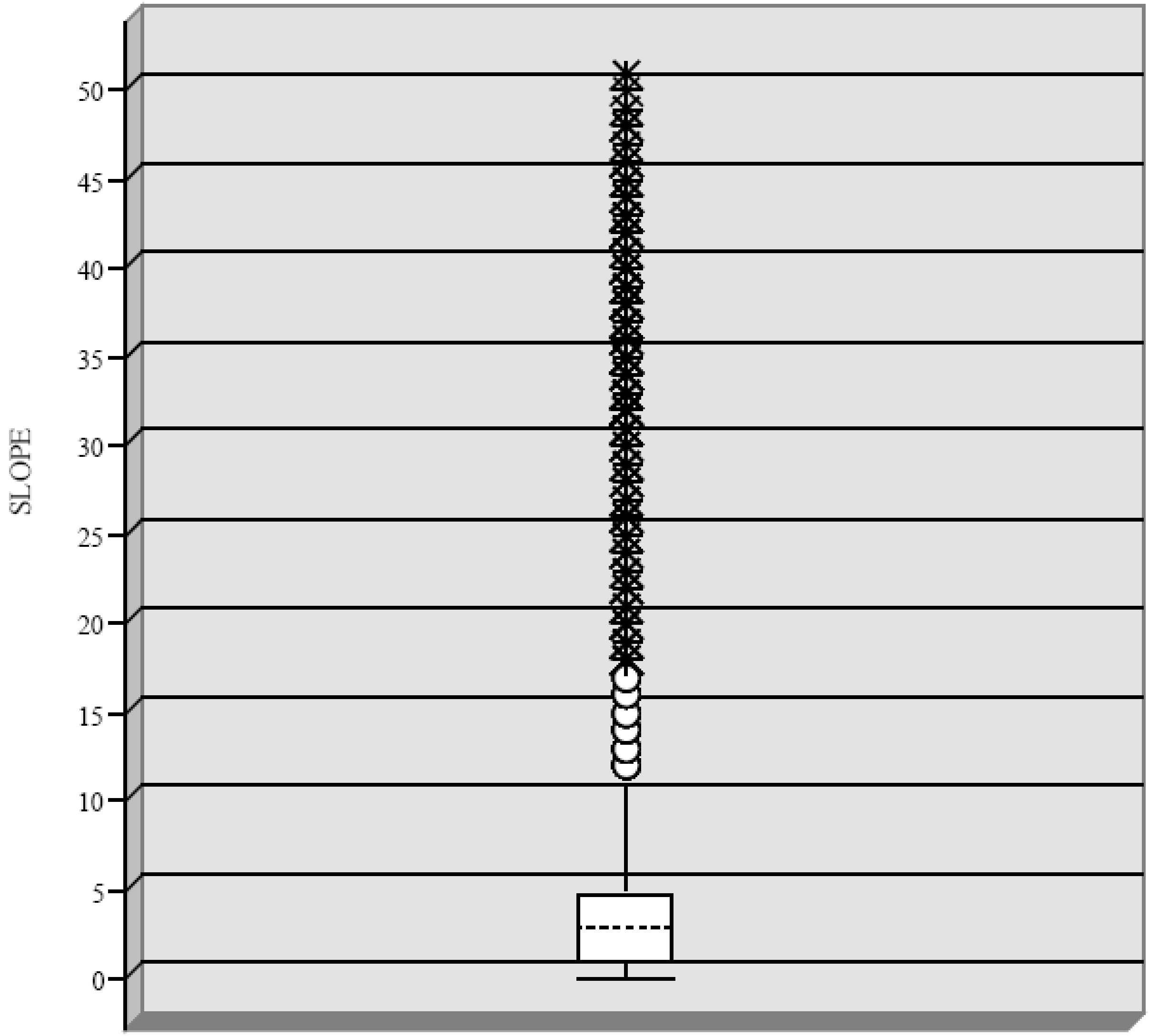

Figure 6.15. Slope Distribution of Regional Sites. (Excluding 30 degrees).

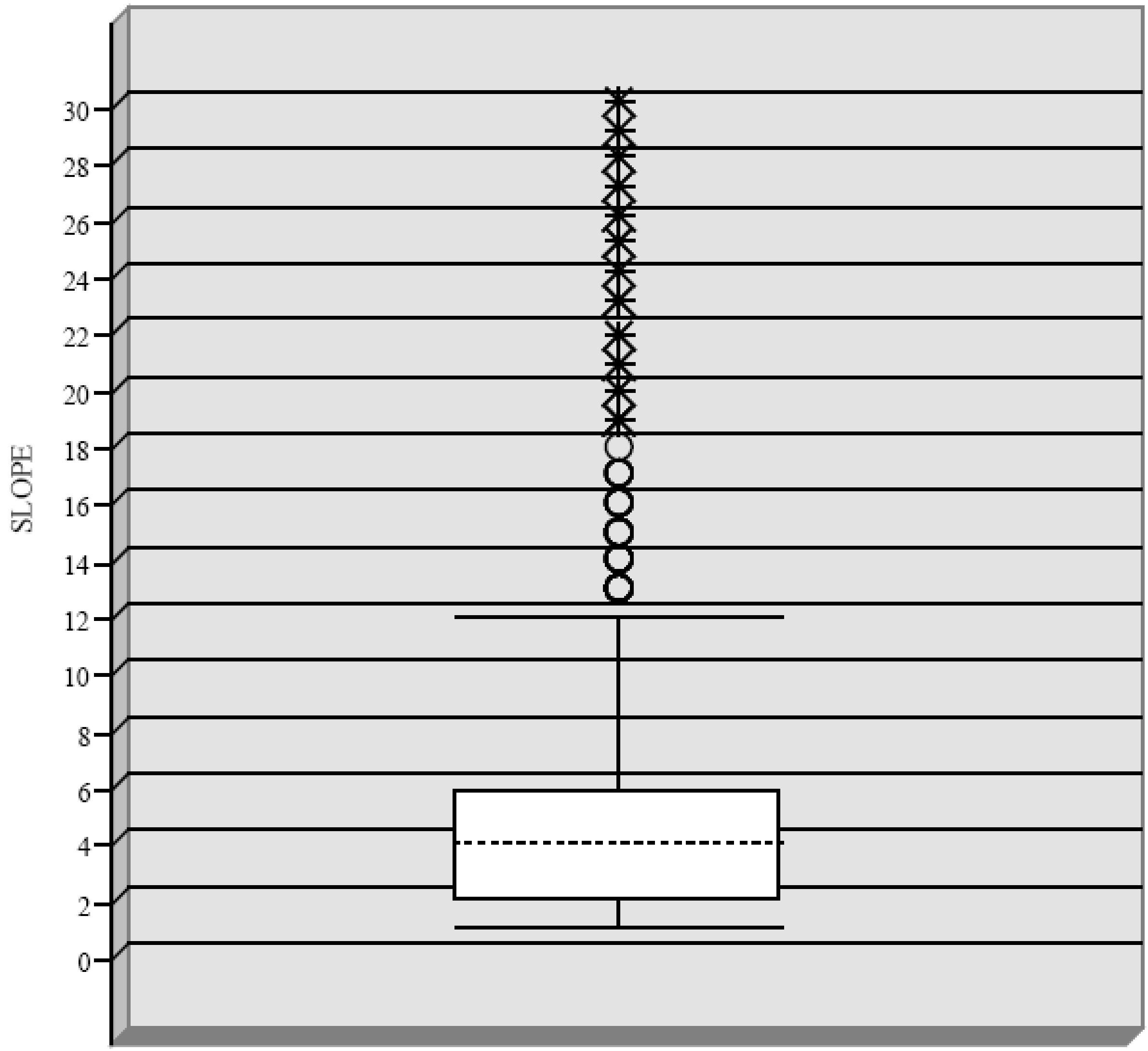

Figure 6.16. Slope Distribution of Habitation Sites (Excluding Those Over 30 Degrees).

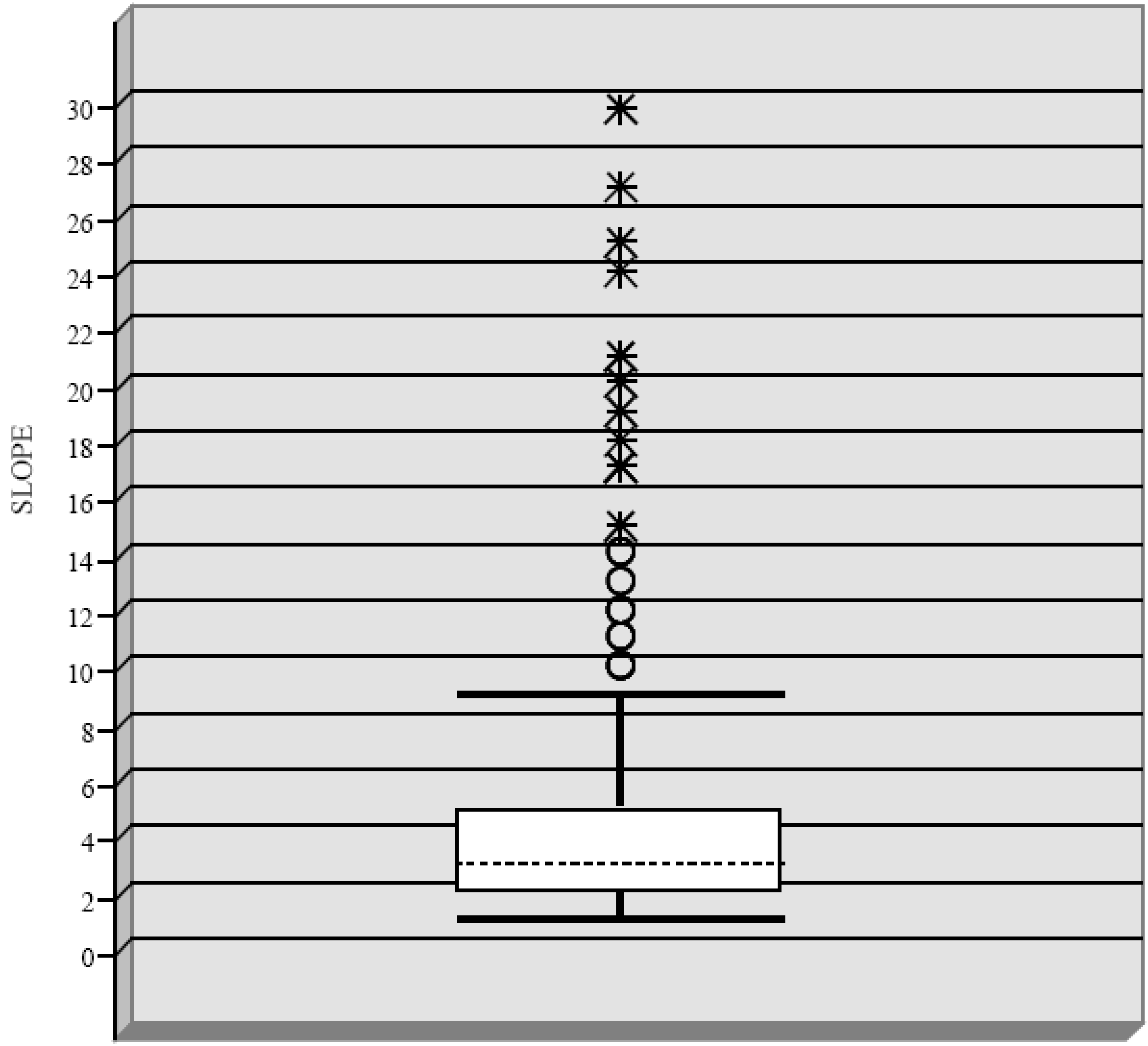

Figure 6.17. Slope Distribution of Agricultural Sites (Excluding Those Over 30 Degrees).

Summary Class	Example site types	Count
Agricultural site	Check dam; field house; agricultural field	841
Habitation site	Pueblo; pit-house; cliff-dwelling; artifact scatter	2080
Other site type	Cave/ rockshelter; ball court; cemetery; rock alignment; rock art; shrine	94

Table 6.1 Site count by aggregated summary class.

Site Class	Observed mean distance	Expected mean distance	Nearest Neighbor score	Z score	p value
Habitation sites (n=2080)	199	373	53.00%	-40.9	<0.01%
Agricultural sites (n=841)	258	548	47.00%	-29.3	<0.01%
Other sites (n=94)	1009	1665	61.00%	-7.3	<0.01%

Table 6.2 Summary of Nearest Neighbor Z-scores by summary class.

Point pattern	Mean Theissen area
Habitation sites	103.8 acres
Agricultural sites	83.5 acres
All regional sites	97.9 acres

Table 6.3 Theissen area by aggregated summary class.

Surface variable	Observed General G	Expected General G	Z score	p-value
Elevation	0.000012	0.000013	-6.816768	0.000000
Aspect	0.000089	0.000076	6.161481	0.000000
Slope	0.000266	0.000076	32.582918	0.000001

Table 6.4 G-function test results by surface variable.

Site layer	Observed General G	Expected General G	Z score	p-value
Regional sites – excluding slope over 30"	0.000089	0.000071	4.831442	0.000001
Habitation sites – excluding slope over 30"	0.000111	0.000092	2.594635	0.009469
Agricultural sites – excluding slope over 30"	0.000266	0.000076	32.582918	0.000001

Table 6.5 G-function test results by site layer.

Chapter 7: National Significance Assessment of Cultural Resources Properties in the Study Area

The assessment consists of identifying any properties in the study area that are individually nationally significant or identifying a group or cluster of properties that collectively is nationally significant. Regarding this task, due to the temporal affiliation of the vast majority of cultural resource properties in the study area, the focus is generally narrowed to the prehistoric ceramic era. The focus of the groups or clusters assessment is on the high archaeological site density settlement pattern in the study area to the north of WACA. The newly discovered cliff dwellings to the west of WACA are the focus of the individual cultural resource properties assessment. However, historic cultural resource properties are also assessed regarding national significance.

National Significance Assessment of Groups or Clusters of Cultural Resource Properties in the Study Area

MNA sought to identify any clustering of cultural resources properties in the study area that exist independently or are an extension of the cluster or clusters that exist within WACA. This is an important step because if clustering cannot be demonstrated then cultural resources properties must be evaluated individually with respect to National Significance. Both visually (see Figure 6.2) and analytically (see Figures 6.4, 6.6, 6.7, and 6.8) newly and previously recorded sites in the study area to the north of WACA are part of the same cluster. The archaeological sites to the north of WACA within the study area while numerous are relatively humble and would not be considered nationally significant if considered individually. Therefore, in order to be considered nationally significant these sites must be argued as being part of a cluster or group that is collectively nationally significant. Put another way, their national significance relies on their association with the arguably nationally significant cliff dwelling sites in WACA.

Clustering of cultural resources properties must be demonstrated not only spatially but temporally as well. In other words, the majority of the properties in a cluster must have components that are inferred as dating to the same time period for the cluster to be considered appropriate for further analysis. If a cluster of properties is defined from both the spatial and temporal perspectives then the national significance criteria can be applied to the whole.

Utilizing archaeological data provided by NPS and the CNF, data obtained though new archaeological survey, and previous research, MNA was able to define a spatially and temporally discrete cluster of cultural resources properties dating to the Elden Phase (A.D. 1150-1225; see Chapters 3 and 5). The cluster consists of properties along and under Walnut Canyon ledges (the famous cliff dwellings), Fort Sites (open air sites located on “islands” formed by the meanderings of Walnut Creek as it carved Walnut Canyon; see Chapter 2), and open air habitation sites located on immediately adjacent rim areas of Walnut Canyon. Previous research (Acord 2005; Bremer 1988) suggested that this cluster is formed of sub-clusters based on different criteria but the whole may be referred to as the Walnut Canyon village. While it has not been formally assessed, the Walnut Canyon village is clearly nationally significant (see Chapter 3). Other Elden Phase site clusters are present in the Flagstaff area but they are located outside and to the north of the study area. In the study area, particularly to the north of WACA, previous research and new survey by MNA documented the presence of numerous small sites. Are these small sites part of the aforementioned Walnut Canyon village? The vast majority of these sites date to the A.D. 1076-1150, before the Elden Phase (see Chapter 5). Therefore, based on current information which consists almost entirely of surface survey data, these sites cannot be argued to be part of the Walnut Canyon Village cluster, which date to the later Elden Phase (A.D. 1150-1225). These small sites must be evaluated individually and none of them merit a national significance designation. In sum, current evidence indicates that the boundary of the Walnut Canyon village is subsumed within the boundary of WACA and does not extend into the study area.

National Significance Assessment of Individual Cultural Resource Properties in the Study Area

The newly discovered cliff dwellings to the west of WACA are the focus of the national significance assessment from the individual cultural resource properties perspective. Eight of the 12 documented sites form a visually apparent spatial cluster (see Figure 5.1). However, from the temporal perspective the cluster is not coherent, particularly (only dateable generally to the Sinagua era) in comparison to the Elden Phase (A.D. 1150-1225) Walnut Canyon Village cluster. Therefore from the national significance perspective we evaluated these sites from the individual cultural resource property perspective. At first blush these properties appear to be potentially nationally significant. Because of this, a line-by-line, so to speak, consideration of these properties is warranted. Below text from the 1999 National Register Bulletin, Section IV (how to evaluate and document national significance for potential national historic landmarks), on how to prepare national historic landmark nominations is quoted at length in italics (the actual criterion language is presented in bold) followed by our assessment. It is important to note that: (1) These criteria are only applicable to the designation of a new National Park Service unit and that a cultural resource property(s) only need to meet one of the criteria in order to be considered nationally significant; and (2) WACA was established by Presidential Proclimation before NHL criteria had been articulated, however, because this assessment is about NHL criteria, we consider the Elden Phase Walnut Canyon Village within WACA to be nationally significant.

NHL Criterion 1:

Properties which are associated with events that have made a significant contribution to, and are identified with, or that outstandingly represent, the broad national patterns of United States history and from which an understanding and appreciation of those patterns may be gained.

The events associated with the property must be outstandingly represented by that property and the events be related to the broad national patterns of U.S. history. Thus, the property's ability to convey and interpret its meaning must be strong and definitive and must relate to national themes. The property can be associated with either a specific event marking an important moment in American history or with a pattern of events or a historic movement that made a significant contribution to the development of the United States.

The property that is being evaluated must be documented, through accepted means of historical or archeological research, to have existed at the time of the event or pattern of events and to have been strongly associated with those events. A property is not eligible if its associations are merely speculative. Mere association with historic events or trends is not enough to qualify under this criterion. The property's specific association must be considered of the highest importance.

Based on surface evidence the newly discovered cliff dwellings cannot be firmly temporally associated with the nationally significant Elden Phase Walnut Canyon village already encompassed by WACA, they can only be inferred to date generally to the Sinagua era, and therefore a national significance claim for them cannot be made under NHL Criterion 1.

NHL Criterion 2:
Properties that are associated importantly with the lives of persons nationally significant in the history of the United States.

MNA's founder, Harold Colton, could be argued to be nationally significant in the intellectual history of the United States (see Chapter 3) because he articulated the concept of the Sinagua culture and its attendant intellectual implications and legacy. Following from this, all archaeological sites that can be inferred as having Sinagua cultural affiliation are associated with Harold Colton. However NHL Criterion 2 states, "…associated importantly…" indicating that not just any association is nationally significant, only important ones. Harold Colton is not known to have had specific knowledge of the newly discovered cliff dwellings while he was formulating the Sinagua concept. So the newly discovered cliff dwellings were not important in the formulation of the Singaua concept. From the perspective of importance to concept formulation the newly discovered cliff dwelling sites are not nationally significant under NHL Criterion 2. However, logically, it should be noted that if one considers every archaeological site with a Sinagua cultural affiliation to be "…associated importantly…" with Harold Colton then a case could be made for the national significance of all archaeological sites with Sinagua cultural affiliation.

NHL Criterion 3:
Properties that represent some great idea or ideal of the American people.

A national significance claim for newly discovered cliff dwellings cannot be made under NHL Criterion 3 because while Harold Colton and the Sinagua concept could be argued to be nationally significant in the intellectual history of the United States the concept has not gone on to become a great idea or ideal of the American people .

NHL Criterion 4:
Properties that embody the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction, or that represent a significant, distinctive and exceptional entity whose components may lack individual distinction.

This criterion's intent is to qualify exceptionally important works of design or collective elements of design extraordinarily significant as an ensemble, such as a historic district. It applies to properties significant for their physical design or construction, including such elements as architecture, landscape architecture, and engineering. The property must clearly illustrate the physical features or traits that commonly recur in individual types, periods or methods of construction. A property also must clearly contain enough of those characteristics to be considered one of the best representatives of a particular type, period, or method of construction. (Characteristics can be expressed in terms such as form, proportion, structure, plan, style, or materials.) A building or structure is a specimen of its type or period of construction if it is an exceptionally important example (within its context) of design or building practices of a particular time in history. The language is restrictive in requiring that a candidate be "a specimen exceptionally valuable for the study of a period, style, or method of construction" rather than simply embodying distinctive characteristics of a type, period, or method of construction. With regard to historic districts, an entity must be distinctive and exceptional. This criterion will not qualify all of the works of a master, per se, but only such works that are exceptional or extraordinary. Artistic value is considered only in the context of history's judgment in order to avoid current conflicts of taste.

The question regarding Criterion 4 is: Are the newly discovered cliff dwellings exceptionally important examples of the Walnut Canyon cliff dwelling architectural style, which is argued to be nationally significant above as a part of the Elden Phase Walnut Canyon village and which is encompassed by WACA.

“One of the best”, “exceptionally important”, and “rather than simply embodying distinctive characteristics of a type, period, or method of construction”, these are the phrases used in Criterion 4. Frankly, when compared to some of the largest and best preserved cliff dwellings in the Walnut Canyon village, the newly discovered cliff dwellings are not “one of the best” examples nor are they “exceptionally important” in defining the Walnut Canyon cliff dwelling site type or architectural style.

It is important to distinguish between the general pattern of the Walnut Canyon cliff dwelling site type and architectural style and the specific entity of the Walnut Canyon village which contains a cluster of cliff dwellings dating to the Elden Phase (A.D. 1150 – 1220). We argue above that the Elden Phase Walnut Canyon village is nationally significant and that it is currently encompassed by WACA. To be compared to Walnut Canyon village, a newly discovered cliff dwelling would need to date to the Elden Phase. If the newly discovered cliff dwelling was only generally Sinagua in cultural affiliation without a firm temporal affiliation and it “simply embodied distinctive characteristics of” the Sinagua Walnut Canyon cliff dwelling “type, period, or method of construction” then it would not be nationally significant because the Criterion 4 language is restrictive to “exceptionally valuable”.

Because of the lack of firm temporal affiliation with the Elden Phase (A.D. 1150 – 1220), a national significance claim for newly discovered cliff dwellings cannot be made under NHL Criterion 4.

NHL Criterion 5:

Properties that are composed of integral parts of the environment not sufficiently significant by reason of historical association or artistic merit to warrant individual recognition but collectively compose an entity of exceptional historical or artistic significance, or outstandingly commemorate or illustrate a way of life or culture.

This criterion is meant to cover historic districts such as Williamsburg, Virginia; New Bedford, Massachusetts; or Virginia City, Nevada, which qualify for their collective association with a nationally significant event, movement, or broad pattern of national development. Most historic districts that are nationally significant for their extraordinary historic importance, rather than for their architectural significance, are recognized by this criterion.

Criterion 5 uses terminology like "exceptional" and "outstandingly commemorate". Further this criterion is about historic districts that are nationally significant because of their historic importance rather that their architectural significance. As has been alluded to, the important historic event or time period is the Elden Phase. We can not specifically infer Elden Phase temporal affiliation to the newly discovered cliff dwellings, therefore they would need to qualify under Criterion 4 ("One of the best", "exceptionally important", and "rather than simply embodying distinctive characteristics of a type, period, or method of construction"), which they do not.

A national significance claim for newly discovered cliff dwellings cannot be made under NHL Criterion 5.

NHL Criterion 6:
Properties that have yielded or may be likely to yield information of major scientific importance by revealing new cultures, or by shedding light upon periods of occupation over large areas of the United States. Such sites are those which have yielded, or which may reasonably be expected to yield, data affecting theories, concepts and ideas to a major degree.

Criterion 6 was developed specifically to recognize archeological properties, all of which must be evaluated under this criterion. Properties being considered under this criterion must address two questions:

1) *what nationally significant information is the site likely to yield? and*
2) *is the information already produced nationally important?*

Answers to both questions must be well documented and logically organized. In order to establish the national significance of an archeological resource, it must be demonstrated how the data has made or will make a major contribution to the existing corpus of information. This criterion requires that potentially recoverable data are likely to substantially modify a major historic concept, resolve a substantial historical or anthropological debate, or close a serious gap in a major theme of American history. It is necessary to be explicit in demonstrating the connection between the important information and a specific property. The discussion of the property must include the development of specific important research questions which may be answered by the data contained in the property. Research questions can be related to property-

specific issues, to broader questions about a large geographic area, or to theoretical issues independent of any particular geographic location.

The current existence of appropriate physical remains must be ascertained in considering a property's ability to yield important information. Properties that have been partly excavated or otherwise disturbed and that are being considered for their potential to yield additional important information must be shown to retain that potential in their remaining portions.

Properties that have yielded important information in the past and that no longer retain additional research potential (such as completely excavated archeological sites) must be assessed essentially as historic sites under Criterion 1. Such sites must be significant for associative values related to:

1) the importance of the data gained or

2) the impact of the property's role in the history of the development of anthropology/ archeology or other relevant disciplines.

"Major scientific importance", "large areas of the United States", and "to a major degree"; these are the key terms expressed by Criterion 6. In the NPS NHL Bulletin it states that two questions must be addressed, with an affirmative answer, for properties to be nationally significant:

1) What nationally significant information is the site likely to yield?

2) Is the information already produced nationally significant?

Regarding the first question, due to the presence of archaeological deposits in sheltered contexts in the newly discovered cliff dwellings it is clear that perishable archaeological resources such as plant parts, textile fragments, string, sandals, basketry, etc. would likely be recovered if excavations were conducted (see Downum et al. 2000). Perishable material is relatively rare in archaeology and this rareness gives these items additional importance because they constitute material culture that is generally not preserved in open-air sites. However, would this material be of major scientific importance in the sense that it would "reveal a new culture, shed light upon periods of occupation over large areas of the United States, or yield data affecting theories, concepts and ideas to a major degree?" Regarding the Sinagua period, it seems unlikely that perishable archaeological resources from the newly discovered cliff dwelling would be of "major scientific importance" or affect "to a major degree" our "theories, concepts and ideas". It is likely that what would be recovered would be additional examples of what Downum et al. (2000) recovered from the Walnut Canyon village area. Any recovered material would augment a sparse database and that would be a welcome development. However, again, it would be unlikely to change our interpretations to a "major degree".

In the vicinity of the newly discovered cliff dwellings, a site has been excavated that yielded split twig figurines dating to the Late Archaic period (Schley 1964). This finding suggests that Archaic period material could be a component of archaeological deposits associated with the newly discovered cliff dwelling sites. However, we must balance this speculation with the reality that the later occupants of the alcoves, the Sinagua, probably heavily disturbed or removed Archaic deposits during the construction and use of their cliff dwellings. The alcove site where the split twig figurines were recovered is unique in that it was not subsequently occupied by later peoples. Further, if additional Archaic period material were recovered would it "substantially modify a major historical concept, resolve a substantial historical or anthropological debate, or close a serious gap in a major theme of American history?" While this is always possible, it seem unlikely based on current knowledge.

In sum, the newly discovered cliff dwellings, based on surface material alone, have not made a major contribution to the existing corpus of information. While the deposits in the newly discovered cliff dwellings are likely to contain perishable Sinagua-aged archaeological resources it is unclear whether this material would significantly change our knowledge of the range of variability pertaining to these items. However, it is possible that it might. There is a possibility that Archaic-aged material is preserved in the newly discovered cliff dwelling sites. Even if this were to be true it is unclear if this material would substantially change our understanding of the Archaic period in the Walnut Canyon area. Again, it is possible that it might. In the end we are left with possibilities that do not measure up to the "major" dictates of Criterion 6.

Finally, regarding a high degree of integrity, the NPS NHL bulletin notes that a property must retain the essential physical features that enable it to convey its historical significance. These essential physical features are those that define both why a property is significant (NHL criteria and themes) and when it was significant. As alluded to above, while the newly discovered cliff dwellings can be inferred to have a Sinagua temporal affiliation, they can not be specifically associated with the Elden Phase (A.D. 1150-1220), which is the time period during which the nationally significant Walnut Canyon village existed. This is because our study was limited to recording surface material only. More research would have to be conducted such as data recovery to recover a larger ceramic assemblage, as well as radiocarbon dating to better determine the age and cultural affiliation of these newly discovered cliff dwellings.

A national significance claim for newly discovered cliff dwellings cannot be made under NHL Criterion 6 based on surface evidence.

National Significance Assessment of Historic Cultural Resource Properties in the Study Area

In assessing whether lands within the study area should be included in a new NPS unit, the character, condition, and significance of historic cultural resource properties must be considered. Documented sites primarily include camps that housed logging and construction crews, logging railroad alignments, and short-term camps for hunting or recreation. The size and condition of these sites varies widely, but most retain enough intact features or artifacts that they can be assigned to a temporal period and often to a specific function. Many of these sites reflect activity important in local and regional economic development, especially those related to logging and ranching. Much of Flagstaff's early history involved development of these extractive industries, including construction of numerous sawmills, logging camps, and miles of temporary railroad grade to transport logs. Indeed, logging and forestry was a crucial aspect of the region's economy through the middle of the twentieth century (Cline 1976, 1994).

Despite their association with these regionally-important economic activities, none of the known historic resources within the study area can be considered nationally significant based on criteria stipulated for designation of National Historic Landmarks (see above). Even sites that retain relatively well-preserved artifact assemblages, which can be used to securely date and assess site function, do not manifest characteristics of national significance. One site that might qualify as nationally significant for context and construction technique, the Santa Fe Dam, is not in Federal jurisdiction and is thus not subject to this assessment. None of the known historic resources are nationally significant as an individual property, nor do the sites present a cumulative district that could be considered nationally significant. This does not diminish their importance in providing evidence of the rich and enduring history of the region, but it does not support the establishment of a new NPS unit.

Summary Statement Regarding the Assessment of the National Significance of Cultural Resource Properties in the Study Area

In sum, based on previous research and the analysis of existing and newly acquired archaeological data, MNA argues that no nationally significant cultural resource properties are present in the study area outside of WACA. Given this, based on an appraisal from solely the cultural resource properties perspective, Interior/NPS cannot suggest a new NPS unit as management option for the study area.

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Appendix 3.1
Chronicle of Archaeological Investigations in the Walnut Canyon Study Area and Other Relevant Events
[Assembled by David R. Wilcox, Museum of Northern Arizona]

1853 Amiel Whipple (1856:81-82) mentions Cosnino Caves at the mouth of Walnut Canyon and San Francisco Wash

1858 Edward Beale (1858) mentions a site near in Walnut Canyon, but apparently did not know about the cliff dwellings (see Stein 1986:49)

1883-1884 J. W. Stevenson (Powell 1887) for the Bureau of Ethnology collected matting, sandals, spindle whorls and stone implements from Walnut Canyon cliff dwellings (Gilman 1976:33; Stein 1986:49)

1884 Excavations in a Walnut Canyon cliff dwelling reported in the San Francisco Call (Cross 1954) mentions finding "cornstalks, corncobs in abundance beans, gourds, uncracked nuts, reeds, arrows, bowstrings, other strings of different size, course cloth, child's sandal, a measuring stick with notches at regular intervals, smoothly worn sticks of hard wood, bone needles, a fish line, soapweed [yucca] needles, broken pottery, etc." (cited in Gilman 1976:38; Stein 1986:53)

1884 Charles Lummis (1892) excavates in Walnut Canyon, finding corncobs and a yucca basket (Stein 1986:51)

1884-1885 F. T. Bickford (Powell 1889) recorded sites for Bureau of Ethnology

1885-1886 J. W. Powell visits the canyon (Riordan 1885; Powell 1889:54)

1887-1888 Victor and Cosmos Mindeleff visit the canyon (Powell 1892)

Jul 1895 J. W. Fewkes excavated relics in Walnut Canyon (Stein 1986:50)

1897-1898 Santa Fe Railroad builds dam in Walnut Canyon (Stein 1986:54)

Spr 1904 San Francisco Mountain Forest Reserve placed a ranger in charge of overseeing the ruins and visitors in Walnut Canyon (Stein 1986:58)

Jun 8, 1906 Federal Antiquities Act signed by President Theodore Roosevelt

1910 H. W. and F. H. Shimer (1910) describe the geology of Walnut Canyon and its cliff dwellings; they report finding few lateral doorways and many obsidian artifacts as well as many sites "scattered over these uplands" beyond the North Rim

Nov 30, 1915 Walnut Canyon National Monument proclaimed by Woodrow Wilson (Stein 1986:61-62) with only 920 acres

1916 National Park Service established and National Monuments transferred to that agency within the Department of Interior, but this did not happen at Walnut Canyon until July 1934 (Stein 1986:62)

Sep 1916 Coltons record sites NA103-108 at Walnut Canyon (Colton 1916; Colton and Colton 1918)

1918 Colton and Colton (1918) publish first survey report about sites in the Flagstaff area, emphasizing they are "small house ruins"

1918 H. S. Colton (1918) publishes first theoretical model of Flagstaff archaeology

Sum 1919 Coltons record sites NA244-269 (Colton 1919; Colton 1932)

Sum 1921 Coltons record sites NA289-338, 385-398, 400-401 (Colton 1921)

Sum 1923 Coltons record sites NA461-474, 475-478, 671-673, 735-748, 775-778 (Colton 1923)

1932 Colton (1932) publishes BAE Bulletin 104 on Flagstaff archaeology

1932 L. L. Hargrave for MNA excavates two rooms in NA739 at Third Fort (Colton 1946:74-76)

Sep 1938 Monument expansion by proclamation of Franklin Roosevelt to 1920 acres with a Santa Fe Railroad inholding of 237.84 acres (Stein 1986:66)

1939-1941 Visitor Center built by CCC (for list of NPS improvements at Walnut Canyon, 1936-1985, see Stein 1986:68)

Spr 1940 Paul Ezell excavates NA311-313

1940 Paul Beaubien excavates a site along entrance road (NA4052?) (Beaubien 1940)

1941 J. Mc.Gregor (1941) publishes his excavations at Winona and Ridge Ruin [Winona lies along lower Walnut Creek below and north of Walnut Canyon]

1946 H. S. Colton (1946) publishes his synthesis of Flagstaff archaeology, The Sinagua

1948 Paul Beaubien reports two BM III sites to MNA (NA5050-5051)

Oct-Dec 1948 Raymond Rixey stabilizes NA735-739, Third Fort Island (Rixey 1948, 1949; Rixey and Voll 1962); artifacts found included thousands of potsherds, 9 complete vessels, cotton fabrics, sandals, basketry, cordage, pottery 8 anvils, 10 arrowshaft straighteners, 60 vesicular basalt cylinders, manos, metates, axes, projectile points, cane cigarettes, a reed arrow shaft, 3 (half) wooden spindle whorls, weaving tools, bone awls and tubes and antler flakers.

Pumpkin, squash, four varieties of beans, yucca seeds, corn, pinyon nuts, walnuts and yucca or agave quids as well as bones of rabbit, squirrel, gopher, packrat, deer, turkey, bobcat and mountain sheep (Rixey and Voll 1962). They also report finding an abalone pendent, a Glycymeris bracelet and a few Olivella beads, as well as (tentatively identified) conus, turitella, terebra and haliotis shell , as well as small balls of azurite, small cylinders of hematite, and agate, disc beads of malachite and turquoise, and pendants of turquoise, steatite, and slate. fragments in trash below a floor in NA739C Rixey recovered a tree-ring specimen dating AD1255vv (Rixey and Voll 1962; Robinson et al. 1975:82-83).

1952 By Executive Order, an easement for an access road to the Monument was established

Fall 1954 Robert Euler and Leland Abel survey proposed right-of-way for entrance road from US66 [no report]

1955 S. Van Valkenburgh began survey of north rim (NA5867-5873, 5879-5892, 5894-5897)

Oct 1955 Gordon Vivian excavates NA331, 333, and 334 below Forth Fort (Richert 1956)

1956 Gordon Vivian (1956) excavates NA5700 along approach road to Walnut Canyon

1957 S. Van Valkenburgh continued survey of north rim (NA6828-6872)

1957 Sallie Van Valkenburgh tests dirt mound, NA5895 (Van Valkenburgh 1958

1958 Vivian and Richert stabilize 29 rooms in sites along Cabin Trail near visitor center, including NA319, 320, 322, 323, and 328

1958 S. Van Valkenburgh completed her survey of north rim (NA7215-7223), recording a total of 78 new sites (of 104 total); three sites may be PI in age (see Van Valkenburgh 1961)

1958 Sallie Van Valkenburgh excavates NA5889

Aug 1960 Stuart Maule excavates two sites in area of ranger residences, including NA5891 [no report]

1961 Robert Schley (1964) recorded Paho Cave west of the monument, collecting 16 prayer sticks

Fall 1961 Robert Euler (1961, 1964) surveys south rim and Wild Cherry Canyon, recording 38 sites, including an early cluster around a hilltop south of Second Fort

1962 Alan Olsen records Walnut Canyon sites along a Bureau of Reclamation 345 KV line (NA8473-8478); NA8477 had Tusayan Poly

Feb 1963 Ted Hiscox and Dennis Campbell find split-twig figurines in cave near the Santa Fe dam; test excavations were later conducted (Euler and Olson 1965; Olson 1966); C-14 dates on two of the figurines were 3880 +/- 90 and 3500 +/- 100 (Gilman 1976:41)

1965 R. Skinner surveys I-40-4(32) and (36), recording 2 sites near Walnut Canyon (NA8785 and 8786)

1965 John Cramer (1965) surveys water-control devices near Ranger Canyon; relocated in 1985 (Baldwin and Bremer 1986)

Oct 15, 1966 Walnut Canyon listed on National Register of Historic Places

1966-1967 Norman Ritchie (1970) and Roger Kelly (1968) excavate NA103 (2 rooms of Elden phase pueblo), a trash area NE of NA103, and NA476 and 478 (small masonry-lined pithouses without floor features); Ritchie proposes hypothesis that the Elden phase rim sites were occupied during the summer growing season and the cliff dwellings were winter habitation sites

1968 Ronald Gauthier NAU survey NE of Fisher Point (on CNF) (NA9844-9853)

1968 Martin Mayer and William Waggoner (1968) stabilize NA103 and NA476, and NA735-739, and 742

1968 Norman Ritchie (1968) writes an administration history of WACA

1969 John Wilson (1969) Harvard Ph.D. dissertation challenges H. S. Colton black sand model and his ceramic chronology

1973 Ed Suddereth (1973; Suddereth et al. 1976) stabilizes NA331-338, 394-398, 400, 401, and 743-747, but records little archaeological information

1976 List of Classified Structures (LCS) completed for 56 sites

1976 Greg Weldon and others survey part of Campbell Mesa for CNF (NA19047-19056)

1976 Pat Gilman (1976) writes archaeological overview of Walnut Canyon

Fall 1976 Small-sites conference held in Tucson (see Ward 1978)

1977 Pat Gilman (1977) surveyed enclosing fence line around the monument, including a 330-acre easement on CNF, recording 17 sites

1983-1989 Grinnell College Field School excavates Lizard Man "Village" above lower Walnut Canyon west of Winona (Kamp and Whittaker 1999)

1985 Intensive Walnut Canyon Survey (Baldwin and Bremer 1986) records 242 sites and reanalyzes previous findings; two main periods of occupation are identified: small-scale use ca.

AD 800-950, especially on the south rim; a hiatus from AD 950-1120; and vigorous use, AD 1120-1200 throughout the locality

1985 In his ASU thesis, Todd Bostwick (1985) reports on the Wilson Project on Section T21N R8E Section 29 in which 6 sites were found (Thomas 1978) and 5 seasonal fieldhouse/farmhouse sites were carefully excavated in 1983

Sum 1985 D. R. Wilcox (1986) excavates portions of two sites (NA19048, 19049), and an alcove-house farmstead (NA19055) on Campbell Mesa with MNA/NAU Archaeological Field School

Sum 1986 D. R. Wilcox (1987) excavates NA19048 on Campbell Mesa with the MNA/NAU Archaeological Field School

Spr/Sum 1987 A. Baldwin (1987) completes the survey of Walnut Canyon NM

May 1988 Jon Michael Bremer (1988) MA thesis on Settlement and Land Use in Walnut Canyon

1988 Christian Downum (1988) completes his University of Arizona Ph.D. dissertation, reevaluating the archaeology of the Flagstaff area

1993 Christopher Harper's (1993) NAU Master's thesis on Walnut Canyon archaeology; based on room area he argues for a dual-settlement seasonal pattern of land use and that the "forts" were community centers, not forts

1994 Monument expanded by US Congress to include First Fort and Fifth Fort areas, for a total of 3289 acres

1995 Report on water use in Walnut Canyon (Downum et al. 1995) in which the peak population is estimated at 185 people and it is found that there was sufficient storage space to store corn for three years and water annually in pots in canyon rooms and use up only 62% of the available enclosed space.

1996 Tom Windes collects tree-ring specimens from two rooms in NA400, Third Fort, and obtains 11 non-cutting dates, AD 1052-1204, and one archaeo-magnetic date, AD 1175-1315

1996 WACA expansion by vote of U. S. Congress and Presidential approval

2000 Publication of analyses of perishable artifacts and botanical remains from NA324 in Walnut Canyon NM (Downum 2000)

2004 L. Theodore Neff and Kimberly Spur (2004) report the results of an intensive archaeological survey of the 1994 additions to the Monument and a 300 m wide corridor on either side of the entrance road, documenting 210 sites, 23 of which were Archaic in age

Aug 2005 Kenny Acord NAU Master's thesis on Ceramic Inventory and Chronology of Walnut Canyon Settlement System

Mar 30, 2009 Public Law 111-11 provides for cooperation between the NPS and USFS to study the management of approximately 30,000 acres that surrounds Walnut Canyon National Monument

2010 Museum of Northern Arizona, cooperating with the National Park Service under the auspices of the Colorado Plateau Cooperative Study Unit (CPCESU) initiates a study to evaluate the national significance of archaeological resources in the approximately 30,000 acre study area